“A COMPARATIVE STUDY OF STANDARD

VERSUS

TUBELESS PERCUTANEOUS NEPHROLITHOTOMY”

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DECLARATION

I solemnly declare that this dissertation titled **"A COMPARATIVE STUDY OF STANDARD VERSUS TUBELESS PERCUTANEOUS NEPHROLITHOTOMY"** was prepared by me in the Department of Urology, Madras Medical College and Rajiv Gandhi Government General Hospital, Chennai - 3 under the guidance and supervision of **Prof. R. Jeyaraman, M.S., M.Ch (Uro)**., Professor & Head of the Department, Department of Urology, Rajiv Gandhi Government General Hospital, Chennai. This dissertation is submitted to The Tamil Nadu Dr. MGR Medical University, Chennai in partial fulfilment of the university requirements for the award of the degree of M.Ch. Urology.

Place: Chennai

Date: **DR.NAVEEN.S**

CERTIFICATE

This is to certify that the dissertation entitled **"A COMPARATIVE STUDY OF STANDARD VERSUS TUBELESS PERCUTANEOUS NEPHROLITHOTOMY"** is a bonafide work done by Dr. NAVEEN.S from Madras Medical college ,Chennai in partial fulfillment of the University rules and regulations for award of M.Ch. (Urology) under my guidance and supervision during the academic year 2011-2014

Prof. R. Jeyaraman, M.S. M.Ch (Uro),
Professor & Guide

Prof. R. Jeyaraman, M.S. M.Ch (Uro),
Professor and Head of the Department,
Department of Urology,
Rajiv Gandhi Government General Hospital,
Madras Medical College, Chennai -600003.

Dr R.Vimala M.D
Dean,MadrasMedicalCollege,
Chennai -600003.

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INTRODUCTION

PCNL is considered to be the standard procedure in patients with large renal calculus. The essential step in standard percutaneous nephrolithotomy (PCNL) procedure is placement of a percutaneous nephrostomy tube for drainage. On the other hand, in recent years, the procedure has been reformed to one called as 'tubeless' PCNL in which a double-J stent without nephrostomy tube is placed for internal drainage.

Urinary stones are defined as the poly crystalline aggregates composed of variable amounts of crystal and organic matrix components. The most common stone types are calcium oxalate, calcium phosphate, uric acid, struvite i.e., magnesium ammonium phosphate and cysteine.

Urinary stone disease is one of those diseases well-known to affect humans ever since olden times.

There has been deviation in the occurrence of stone disease from the lower to upper urinary tract. The occurrence of stone disease is 2 to 3 times more in young males than females in the past nevertheless this difference is now declining.

The estimated prevalence of renal stone disease is 1% to 5%. Soucie et al proposed that the prevalence of stone disease is 10% in males

and 4% in females[1]. Whites are commonly affected than Asians and Afro-Americans.

The incidence of stone disease is highest in fourth to sixth decades. Hot arid climate, obesity and sedentary lifestyle predispose to stone formation.

Hippocrates had described the renal colic symptoms as follows:

"An acute pain is felt in the kidney, the loins, the flank and the testis of the affected side. The patient passes urine frequently. Gradually the urine is suppressed. With the urine, the sand is passed."

There had been a vast progress in the evaluation, imaging and management of this disease. Initially the management procedures had significant morbidity and sometimes mortality.

With advances in surgical techniques, the mortality has reduced considerably. PCNL had improved reasonably over the last twenty years as a result of technical advancements and perfections in surgical skill for doing PCNL. A milestone in the history of PCNL is the introduction and development of the 'tubeless PCNL' which is now been proposed to have a comparatively lesser morbidity rates than the standard procedure. The purpose of this study is to analyse the evidence -based literature regarding the 'nephrostomy-free' or 'tubeless' PCNL and to assess the safety, efficacy, possibility, and benefits of tubeless PCNL over standard PCNL.

AIM AND OBJECTIVE

Primary Objective

To systematically review and compare tubeless percutaneous nephrolithotomy (PCNL) with standard PCNL

- Safety
- Effectiveness
- Feasibility
- Postoperative pain
- Morbidity
- Hospital stay

REVIEW OF LITERATURE

Urinary stone disease- A History

Humans were being affected by urinary stone disease since time immemorial. The oldest renal stone documented in writings was the one founded in an Egyptian mummy in a tomb dating to roughly 4400BC[2].This was documented in literature by Shattock. But then only in the 19th century, all urinary stones known today were identified, defined and named.

Even though stone disease had been studied by physicians and surgeons for thousands of years, the major part of the evolution in the stone analysis took place in the last two centuries.

The management of renal calculus is largely divided into medical and surgical.

Medical management is done in asymptomatic patients with minimal stone burden. It also helps to prevent recurrence of certain types of stones. Initially medical management was not very successful because of insufficient knowledge regarding the pathogenesis of stone formation.

With betterment in knowledge regarding the pathogenesis and technical advancements, medical management has improved a lot and

now plays an important role in the renal stone management. Besides treatment of the stone disease, there is an extremely important necessity to tackle the recurrence of stone formation.

Surgical management continues to be the mainstay of treatment in numerous patients. Surgical management of stone disease has evolved over many centuries to the present state.

Prehistoric literatures state that surgical management was attempted enthusiastically despite increased incidence of morbidity and at times mortality.

The technique of removal of urinary tract stones done in Egypt had been described by Eric Riches as follows:

"The urethra was dilated by a wooden or cartilaginous cannula as thick as the thumb pushed in with great force alternating with blowing down the urethra; the stone was pressed down into the perineum by the fingers in the rectum until it could be reached from the urethra or sucked out by the mouth[3]".

PATHOPHYSIOLOGY

The most common type of stone is of the calcium variety. The etiology of stone formation is probably multifactorial. A complex cascade of events occurs as the glomerular filtrate traverses the nephron and this result in stone formation. To start with the urine becomes supersaturated with the respective stone forming salts. But this supersaturation alone is not enough for the crystallisation to occur as there are urinary inhibitors which promptly prevent aggregation of crystals whenever there is supersaturation of stone forming salts.

Nephrocalcin, Uropontin, and Tamm-Horsfall Protein are important inhibitors of crystal nucleation, growth, or aggregation.

In case of the commonest stone type i.e., calcium stones, both the urinary calcium and oxalate play an important role in the supersaturation and formation of calcium oxalate crystals. Subepithelial plaques composed of calcium apatite form initially and they act as a platform on which calcium oxalate stones develop. The noncrystalline component of stones is called matrix. This matrix constitutes mucoproteins, proteins, carbohydrates, and urinary inhibitors.

MEDICAL MANAGEMENT

Medical management of stone disease had evolved over centuries to the contemporary status. Improved knowledge on the subject of pathogenesis of stone formation had facilitated the improvement.

Therefore nowadays some form of medical treatment is being suggested to the patients with renal calculus regardless of the aetiology of the disease.

ROLE OF FLUID INTAKE

Patients are advised to increase their fluid intake accordingly that their ultimate urine output at the end of the day is not less than 2 litres. This sort of physiologically induced diuresis prevents stagnation of urine thereby reducing the formation of stones. This also helps by altering the specific gravity of urine i.e., by producing dilute urine and thereby preventing supersaturation of various components responsible for formation of stone[5].

Hosking and associates defined a phenomenon named “stone clinic effect” in single stone formers according to which increase in fluid intake in the above said patients results in reduced recurrence of the same[4].

It has been observed that the hardness of drinking water has no role in stone formation.

Carbonated drinks especially the ones with citric acid as acidifier have been found to protect from formation of stones[5].

A number of studies have concluded that the amount of fluid taken is important than the type of fluid. Therefore it is desirable to take a minimum of 3000ml of fluid a day so as to maintain an output of 2500ml a day.

ROLE OF DIET

Latest studies shed light on the role of diet in stone formation. Dietary modifications play a significant role in preventing stone formation. Diet has a significant role in the increasing incidence of stone disease in females.

Animal protein intake in large amounts predispose to stone formation. Higher incidence of stone disease in northern and western parts of India compared to eastern and southern parts has been attributed to increased intake of animal protein in the above mentioned regions. Excess excretion of calcium, uric acid and oxalate in those with increased animal protein consumption predispose to stone formation.

Restriction of dietary sodium intake is one more essential way of decreasing stone recurrence[6]. Basis of this concept is that high sodium in the diet results in increased levels of sodium and calcium in urine and also increases its pH level whereas it decreases the citrate level in urine thereby facilitating crystallisation of calcium in urine. Therefore moderate sodium restriction aids to prevent recurrence[7].

Modest intake of calcium is always recommended in patients with calcium stone, meaning severe restriction of dietary calcium results in increased oxalate absorption thereby causing calcium oxalate supersaturationin urine. Hence calcium intake in moderate amounts is recommended[8]. Calcium citrate supplements are more stone friendly than other calcium compounds and hence preferred[8].

Oxalate stone formers are advised to avoid oxalate in diet and restrict their ascorbic acid intake to less than 2 grams per day.

Selective medical treatment is very effective and hence preferred to prevent recurrence of certain types of stones. Use of citrate in hypocitraturic patients, alkalisation of urine to increase pH, use of mercaptopurine, D-penicillamine or captopril to increase the solubility of cysteine, use of urease inhibitor acetohydroxamic acid in stones of

infective etiology and avoidance of drugs inducing stone formation are a few selective medical treatments available.

Incidence of stone diseases is higher in persons with increased body mass index. This tendency is higher in females than males. Various studies have revealed that metabolic syndrome predisposes to stone formation[9].

SURGICAL MANAGEMENT

Surgery for stone disease is largely into open procedures and endourological management.

OPEN PROCEDURE

The alleged first attempt of stone removal in a patient is the story of French archer of Bagnolet. The surgeons then claimed removal of a renal calculus in a condemned individual who was offered freedom in return if he admits to undergo the crude procedure. That man withstood the procedure and survived following stone removal and hence he was freed as per the agreement in 1474. As there are no first hand records, the authenticity of this event is doubtful.

The very first provable event of renal surgery was in 1550 when Cardan of Milan operated on a teenage girl with lumbar abscess and

removed 18 calculi. At that time, the consensus was to operate in those patients with infections in kidneys due to calculus.

In 1734, Lafite drained an abscess bulging through the loin but the persistent drainage of pus for days together made him to extend the original incision and he ended up removing two calculi. He also treated a patient with urinary fistula due to renal calculus. He suggested that treatment of underlying stone disease will relieve the patient of his symptoms and also removal of the renal stones will save the patient from undergoing multiple procedures.

In 1872, William Ingalls explored the persistent fistulous tract with a forceps and extracted a calculus from the kidney and this being the very first nephrolithotomy in Boston, USA[10].

In 1880, Henry Morris performed the first nephrolithotomy in England and removed a mulberry calculus.

With advances in technology, the procedure became more refined and the hemorrhagic complication was brought to control with usage of modified incisions.In 1879, Heineke simplified the pyelotomy incision that became popular thereafter. The main disadvantage of this incision was that it could not be extended to extract larger calculi.

More efforts were made to reduce the complications which led to the discovery of an avascular plane immediately posterior to the convex border of the kidney described by Josef Hyrtl (1882) and Max Brödel (1902). This plane was termed as “Brödel’s bloodless line or white line” (Schultheiss and associates, 2000)[11].

Despite the improvements in the techniques complications occurred. Zuckerkandl introduced the inferior pyelolithotomy incision in which the original pyelotomy incision was extended into the lower pole. Another discovery was a V incision into the poles. Other methods to control hemorrhage were hilar compression to occlude the vessels and a few innovative surgical techniques.

Czerny in 1887described a new suturing technique to control hemorrhage and it was claimed that it would significantly reduce the development of pyelocutaneous fistula.

Guyon described the side effects of nephrectomy which was then the universally preferred treatment for calculus pyonephrosis especially for bilateral stone disease. During that time nephrectomy was considered to be a relatively easy procedure than stone extraction.

Kummel in 1889 did a nephron sparing surgery, the first of its kind, for stone disease. Lower in 1913, recommended pyelolithotomy

over nephrolithotomy as the former method was comparatively safer and easier than the later. Murphy and colleagues conducted a study in 1972 and proposed that there is no difference in the recurrence rate of stone disease following nephrolithotomy and pyelolithotomy. Henceforth pyelolithotomy became the preferred procedure.

Dees and Fox demonstrated the removal of stones with the use of a coagulum made from the combination of fibrinogen and thrombin. This coagulum was introduced into the renal pelvis to make a cast of it. The risk of transmissible infection limited its use (Marshall, 1983). Fischer and associates in 1980 made use of cryoprecipitate to form coagulum as it is a rich source of fibrinogen. It was considered to be relatively safer and also it was easily available[12].

A breakthrough in the surgical management of stone disease was made by Gil Vernet in 1965 when he demonstrated the procedure called extended pyelolithotomy. Henceforth this became the procedure of choice for patients with large and complex calculi. It is now widely used with acceptable minimal morbidity. Further advancements were made by combining this with nephrotomies by extending the incision in radial directions as and when required.

In 1968, Smith and Boyce recommended a method of approaching the kidney by making the incision through the bloodless field. This procedure was termed “Anatrophic Nephrolithotomy” as the procedure did not interfere with the parenchymal blood supply and hence no atrophy of parenchyma. This helped in successful removal of stone with restoration of calyceal anatomy and capsular integrity and thereby preserved renal function. But the morbidity related to the open procedures remained high and therefore the quest for a better approach continued.

ENDOUROLOGY IN STONE DISEASE

Arthur Smith defined endourology as “closed controlled manipulation within the genitourinary tract”

Wolf in 1979 introduced the first rigid endoscope for use in urology.

Harold Hopkins developed the rod lens system and this led to the making of smaller ureteroscopes with more clarity and better working channels.

Development of various energy sources to fragment calculi intracorporeally led to further developments in the field of endourology.

Gain of access into the collecting system is the most important thing in the success of percutaneous nephrolithotomy.

The first therapeutic percutaneous nephrostomy was done by Thomas Hillier in 1865 (Bloom et al, 1989).

PERCUTANEOUS NEPHROLITHOTOMY

Technical advancements in endourology led to removal of renal calculus by percutaneous access for the first time by a Swedish Urologist named B. Johannson and a radiologist named Fernstrom in 1973 and subsequently in 1976[13].

The prototype was not a single step procedure as the one done now. Initially the procedure was done in several sittings over twenty days. First a percutaneous access tract to the pelvicalyceal system was established followed by introduction of a series of polypropylene semirigid dilators to progressively increase the size of the tract. These dilators were sterilised in steaming water before introduction. The final tract achieved was 20 Fr in size. Surgeons waited for the tract to mature and then extracted the calculus using a dormia basket. This very first procedure done to extract the renal calculus, though successful, was time consuming and tedious both for the patient and the doctor.

Peter Alken, Michael Marberger, Wickham, Ronald A. Miller, Joseph Segura and Ralph Clayman pioneered in improving the methods of accessing the pelvicalyceal system[14,15].

ACCESS TO THE COLLECING SYSTEM

A sound knowledge on renal and perirenal anatomy is essential in gaining a safe and useful access to the pelvicalyceal system. Mobility of kidney with respiration and other normal variations in anatomy are some of the practical difficulties in obtaining an access.

A complete knowledge about the relative location of both kidneys in relation to vertebral bodies and their orientation and tilt in relation to the spine are important for success.

The risk of injury to the pleura and at times the lung while gaining access to the pelvicalyceal system has to be considered.

There is a risk of injury to the colon in patients with retro renal colon. This is seen more commonly over the left side in thin individuals and also females.

The knowledge on anatomy of the collecting system is similarly important for successful access. The outmost part of the collecting system is the minor calyx. These minor calyces unite to form a major calyx that drains into the pelvis via infundibulum. It might be difficult in gaining access in patients with infundibular narrowing[16].

Minor calyces draining only one papilla are called simple calyces while those draining multiple papillae are termed complex calyces. Complex calyces are commonly located in poles. The simple calyces are arranged in two rows and are located anteriorly or posteriorly[16].

Orientation of these calyces is important in determining the best access tract. The anteroposterior orientation also varies with the side.

Two types of orientation have been described. In the Brodel type, the posterior calyces form an angle of 20° with the frontal plane, meaning that the posterior calyces are located laterally. In the Hodson type, the posterior calyces form an angle of 70° with the posterior plane, meaning that the posterior calyces are located medially.

Brodel type of orientation is more common on the right side whereas the Hodson type is commonly seen on the left side.

Vast studies conducted so far have revealed that posterior calyceal puncture made through the fornix is the ideal site for entry with minimal complications and hence is the favoured approach over others and the level of entry is decided by the position of the calculus within the kidney.

Subcostal access is the safest place to enter[17].

ACCESS ROUTES

Gain of access into the upper tract collecting system is accomplished by both antegrade and retrograde approaches.

Indications for antegrade access include percutaneous endopyelotomy and endoureterotomy, nephrolithotomy, calyceal diverticula, hydrocalyces and antegrade ureteroscopic treatment of large ureteral stones, percutaneous resection of urothelial tumors and management of fungal bezoars.

ANTEGRADE ACCESS

Antegrade access is the standard approach followed for creating a percutaneous tract. A 21G or an 18G needle is inserted into the collecting system under either fluoroscopic or ultrasound guidance. And then a guide wire is introduced into the system.

The tract is created by dilatation with rigid metal dilators introduced by Alken. These coaxial stainless steel dilators are passed over a rigid guide rod. The ball tip of the rod prevents overshooting of the dilators. This is particularly suitable for those with dense fibrous tissues surrounding the kidney. It is also more traumatic to the surrounding tissues.

Another choice is to use polyurethane semirigid Amplatz dilators. The dilatation is done in increments of 2 Fr size and the first dilator has to be removed before introducing the next higher sized dilator. The advantage of using these dilators is that they are less traumatic to the tissues. But the disadvantage is that there is a risk of haemorrhage each time the dilator is removed to insert the larger one[18].

Balloon dilators were introduced to overcome these difficulties but these are more expensive than the previous ones. Moreover these balloon dilators are less useful in densely scarred tissues.

Of late single step dilatation techniques are performed using semirigid plastic dilator, rigid dilator with a sheath and balloon dilator with an expandable sheath[19]. Antegrade access is gained under fluoroscopic or ultrasonographic guidance[20]. But even today blind procedure is under practice.

Pedersen invented the method of access under ultrasonographic guidance in 1974. Advantages of this method include use of portable machines and absence of radiation hazards. Disadvantages are operator dependability, difficulty in visualisation of the needle and also further monitoring is difficult.

Fluoroscopic method is the one commonly used. The two different techniques are “eye of the needle technique” and “triangulation technique”[21].

RETROGRADE ACCESS

Retrograde access is very useful in obese individuals, anomalously located kidneys and hypermobile kidneys. Retrograde transurethral access is created by placement of a 5 Fr or a 6 Fr ureteric catheter followed by injection of contrast into the pelvicalyceal system in order to delineate and dilate the system. Now the guidewire is introduced into the system and is brought out via the percutaneous tract by grasping it with a nephroscope.

An ureteroscope can also be used to create a tract by retrograde access.

POSITIONING OF THE PATIENT

Proper positioning of the patient for the procedure is very important. Prone position was first employed by Goodwin in 1955 to establish percutaneous access route. Prone position is the most favoured position as posterior calyceal puncture is easy to perform in this position. Also this position provides a wider area of access and a stable work surface.

Disadvantages of operating in this position include decrease in the cardiac index, diminished vital capacity if not padded properly, neuro musculoskeletal complications, ocular injury, rhabdomyolysis and difficulty in maintaining the airway[22].

This difficulty was overcome by operating in supine position and this was recommended by Valdivia Uria in 1987. In this position anterior calyces were entered by a lateral or anterolateral approach[23].

Advantages of this position are the access sheath angle is horizontal and hence allows the fragments to get washed out easily because of reduced pressure inside the collecting system. As there is easier access to the urethra in this position no repositioning of the patient is required.

Disadvantages are that this procedure is unfamiliar for the operating surgeons, and as well there is poor visualisation due to low collecting system pressure. And access to the upper pole is not easy in this position.

Other variants of this position are supine with same side elevation, supine with same side flank elevation, asymmetrical lithotomy position and flank position.

A nephrostomy tube is placed along with placement of a ureteral stent or catheter after successful fragmentation of stones and retrieval of the fragments. Nowadays tubeless procedure is done i.e., a nephrostomy tube is not placed in patients with complete clearance of stones[24]. Further advancement in the technique is performance of a totally tubeless procedure in which placement of a ureteric stent is also avoided[25].

With the intention to avoid infectious complications pre-operative treatment of infections to make the urine sterile is always ideal. But then, it is not simple to achieve this goal in particular situations like anatomic abnormalities, recent hospitalisation, and presence of any infective foci in the body and in patients already with urinary catheter. These individuals require urine culture and treatment according to the sensitivity pattern.

The protocol usually followed is to do a urine culture in patients with staghorn calculus and in those patients with a percutaneous drainage catheter. Rest of the patients require only urinalysis. Culture is indicated only if urinalysis is abnormal. Patients with positive cultures are treated with a complete course of antibiotics according to the sensitivity. Periprocedural antimicrobial prophylaxis is recommended in all patients undergoing percutaneous renal surgery by American Urological Association (Wolf et al, 2008)[26].

Nonrandomized trials show an infection rate of 35% to 40% if no antimicrobial prophylaxis is used compared with 0% to 17% if prophylaxis is used (Charton et al,1986; Darenkov et al, 1994)[27].

The recommended prophylaxis is the use of first or second generation cephalosporins with either aminoglycosides in normal patients or aztreonam in patients with elevated renal parameters. Furthermore metronidazole, clindamycin or a fluoroquinolone can be prescribed. Prophylactic antibiotics can be given for 24 hours.

COMPLICATIONS OF PERCUTANEOUS NEPHROLITHOTOMY

Although percutaneous nephrolithotomy is effective in the treatment of stone disease it is not without any complications.

The most common complication of this procedure is hemorrhage. Blood transfusion is required in 0.5% to 4% of individuals undergoing percutaneous nephrostomy alone due to significant hemorrhage[28]. 6% - 20% of patients who undergo percutaneous nephrolithotomy require blood transfusion[19].

The main source of hemorrhage in these patients is parenchymal vessels. On table, the access sheath acts as a tamponade. If there is bleeding postoperatively the nephrostomy tube can be inserted and kept

closed. The incision can be compressed as well and the clots removed from the collecting system. If the above measures do not control hemorrhage, we can go for selective angioembolisation[29].

Delayed hemorrhage is seen in around 1% of the patients and it is due to arteriovenous fistulas or pseudoaneurysms.

Angiography followed by selective embolization of the vessels is the treatment of choice for these complications.

Recent advancement in the treatment is the placement of endovascular stents inside the bleeding vessel followed by ultrasound guided injection of thrombin or tissue adhesive[30].

Injury of the collecting system like pelvic perforation might occur which is identified by sudden collapse of the renal pelvis. This results in massive extravasation of fluid. If the perforation occurs the procedure should be stopped followed by placement of both nephrostomy tube and ureteral stent[31].

Injury to the abdominal viscera like colon, duodenum and jejunum can occur in some patients. Patients with extraperitoneal colonic injury can be managed conservatively by placing separate drainage for colon and kidney[32]. Intraperitoneal injury has to be repaired. Liver and splenic injuries rarely occur.

In supracostal access, pleural and lung injuries most likely occur. A costal drainage is placed in such types of injuries[33].

In some patients where normal saline is used for irrigation, it might get extravasated at times resulting in metabolic and electrolyte imbalance. Venous gas embolism if occurs proves to be fatal.

Fever occurs in 15% – 30% of the patients postoperatively. Despite the use of prophylactic antibiotics systemic inflammatory response also occurs in a few patients.1%-2% patients develop frank sepsis ultimately.

Various studies conducted so far suggest that preoperative treatment of only those patients with positive urine culture is not enough as postoperative sepsis has also developed in those patients with sterile preoperative urine cultures.

Hence it is important to treat the fever patients with full course of antibiotics to prevent the development of sepsis following PCNL[34].

TUBELESS PERCUTANEOUS NEPHROLITHOTOMY

Formerly the opinion was that placement of nephrostomy tubes has many advantages like maintenance of hemostasis along the tract and prevention of extravasation of urine while adequately draining the kidney[35]. Nevertheless the basic purpose of placing a nephrostomy tube is

only adequate drainage of the kidney the concept of tubeless PCNL was proposed.

The tubeless procedure is nothing but placement of a ureteral stent or a catheter without a nephrostomy tube to provide adequate drainage of the kidney after PCNL.

The concept of tubeless procedure was considered even in the early period of evolution of PCNL, the proof being a study conducted by Wickham in 1984[36] on 100 patients in whom neither external drainage nor internal drainage tubes were placed and the results were published. The results were encouraging and the patients who underwent this procedure were discharged within 24 hrs and the conclusion was that the tubeless PCNL was harmless and effective with a relatively shorter admission period.

But later Winfield and associates[35] provided a report about two patients who underwent nephrostomy tube removal prematurely following a simple upper urinary tract calculi extraction. These patients later developed complications like life threatening hemorrhage requiring blood transfusion, significant amount of urinary extravasation and therefore they had to undergo internal stenting and consecutively had a prolonged hospital stay. And hence the recommendation was that for the

initial 24 to 48 hrs following PCNL drainage with a nephrostomy tube must be provided. This turned out to be the standard procedure in the following years globally.

Again in 1997 Bellman et al[37]opposed the practice of routine insertion of a nephrostomy tube following PCNL. They conducted a study in which 50 patients were in the study group and 50 patients were in the control group. The study group underwent tubeless PCNL procedure in which only ureteral stents were placed inside and no nephrostomy tubes were kept whereas the control group underwent the standard PCNL procedure with the placement of a nephrostomy tube.

The length of hospital stay, requirements of analgesics, time taken to come back to normal and the total cost were the parameters compared between the two groups.

The conclusion was that the study group had a shorter hospital stay with less analgesic requirements and lesser hospital expenses and they returned to their routine life quicker compared to the study group.

Candela and colleagues[38] studied the cost of a standard PCNL versus a tubeless procedure and published that the cost of standard procedure was high compared to that of a tubeless procedure.

Numerous studies conducted so far had shown that tubeless PCNL is comparatively good and harmless and also morbidity is lesser if done in selected patients [39-42].

MATERIALS & METHODS

SUBJECT SELECTION:

Cases include patients with renal calculus disease who undergo PCNL for the same in the Dept. of Urology. It is a prospective study done between April 2013 to March 2014.

100 cases of stone disease with stone size more than 2 cm who undergo PCNL in the Dept. of Urology, Madras Medical College.

Patients are divided into two groups (Group A& Group B)

1. Group A - 50 cases of tubeless PCNL
2. Group B - 50 cases of standard PCNL

INCLUSION CRITERIA:

1. Stone size more than 2 cm who underwent PCNL as primary procedure
2. Single puncture tract
3. Procedure lasting less than 2 hrs
4. Less than three stones with a diameter <25 mm
5. Complete extraction of all stones

6. No significant bleeding at the end of the procedure

.

EXCLUSION CRITERIA:

1. Residual calculi
2. Significant bleeding at the end of procedure
3. Multiple puncture tract

METHOD OF STUDY

INVESTIGATIONS

Patient were evaluated with physical examination, urine analysis, urine culture and sensitivity , complete blood count , renal function test , X-ray KUB, and Plain and contrast enhanced computerized tomography / IVP

Group A underwent tubeless PCNL and Group B underwent standard PCNL after obtaining anesthetic fitness for the procedure.

All patients were administered 1 gm of ceftriaxone and 500 mg of amikacin as standard antibiotic prophylaxis for a period of three days including one preoperative dose. Patients with preoperative serum creatinine greater than 1.4 were not administered amikacin.

All patients underwent PCNL under general anesthesia. Patients were placed in lithotomy position and a 5 Fr ureteric catheter was introduced. Contrast was used to identify the collecting system and to select the calyx for puncture.

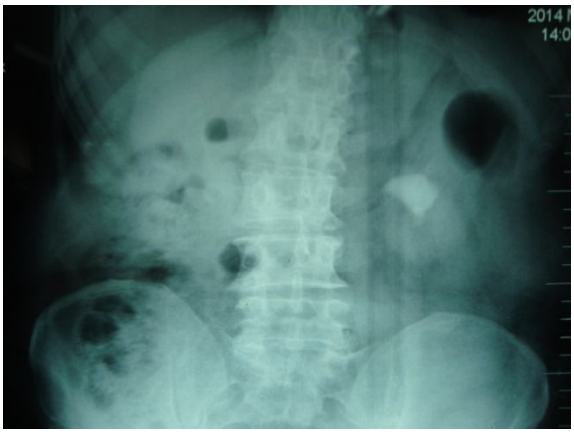
After prone positioning with adequate padding posterior calyceal puncture was done under fluoroscopic guidance. Level of puncture was decided as per location of stone to ensure complete clearance.

Puncture was done using 18 G three part needle and guide wire was placed within the system. Guide rod was introduced and serial coaxial dilatation of tract done with Alkens metal dilator. Amplatz sheath was placed. Using 26 Fr KarlStorz nephroscope and KarlStorz pneumatic lithotripter stone fragmentation was done.

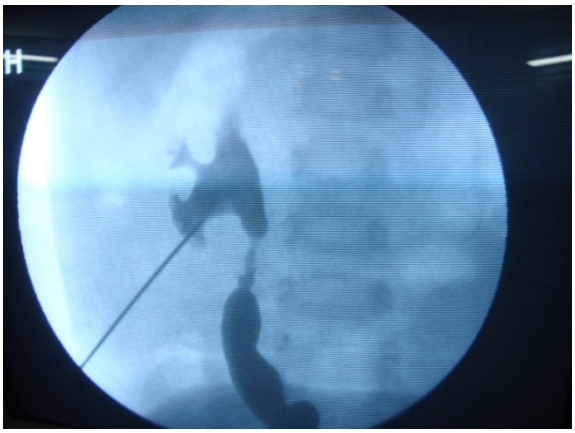
After fragments were evacuated antegrade 5 Fr ureteric stent was placed in group A and skin incision sutured and compression bandage applied. A 20 Fr nephrostomy tube along with 5 Fr ureteric stent was placed in patients coming under group B.

Preop parameters like stone size, stone disease in the opposite kidney and ureter, preop creatinine and associated comorbidities were recorded.

Intraoperative parameters like operative time, access tract and the need for blood transfusion were recorded.



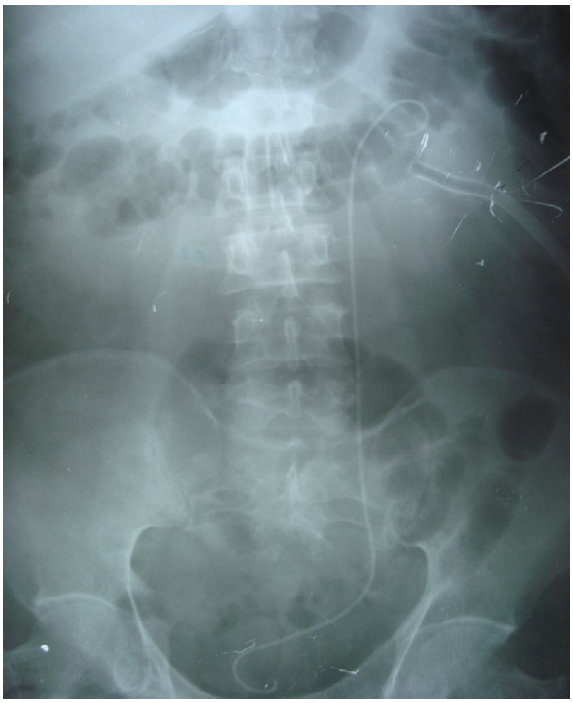
Left Renal Calculi



Lower Calyceal Puncture

Standard PCNL with nephrostomy tube

Tubless PCNL



Post of Xray KUB – Standard PCNL

Post of Xray KUB – Tubless PCNL

Patients were followed up in post op period with drop in Hb, need for blood transfusion, need for analgesia, hospital stay, complications and need for ancillary procedure.

Post procedure check X-ray KUB was taken before removing the nephrostomy tube in the first postoperative day in the standard PCNL group. Calculi size more than 4 mm consider residual calculi.In both group A&B ureteric stent was removed after 14 days.

DATA COLLECTION METHODS

Stone size, preop creatinine, operative rate,stone clearance rate,Length of hospital stay, analgesic requirements and postoperative complications such as bleeding, infection or ureteral obstruction, Hospital readmission rates were recorded and compared.

STATISTICAL ANALYSIS OF THE STUDY

For discrete data proportion are computed and the mean and standard deviation are computed for the continuous data. The chi square test was applied to compare the proportions between the groups. All analyses were two tailed and $p < 0.05$ was considered significant. Independent sample T test was used to compare the difference between

two groups. Statistical package for social sciences (SPSS) version 17.0 was used for data analysis.

Concept of P value

- If the P value is 0.000 to 0.010, then denoted by **, it implies Significant at 1 level (Highly Significant)
- If the P value is 0.011 to 0.050, then denoted by *, it implies Significant at 5 level (Significant)
- If the P value is 0.051 to 1.000, then not given a star, it implies Not Significant at 5 level(Not Significant)

Note: If the P value is .000 then write it as <0.001**

OBSERVATION AND RESULTS

TABLE-1: AGE DISTRIBUTION-DESCRIPTIVE STATISTICS

	N	Minimum	Maximum	Mean	Std. Deviation
Age in years	50	13	65	37.78	12.671

In group A, the lowest age was 13 and the highest age was 65 (table-1).

TABLE-2: COMORBIDITY - FREQUENCY TABLE

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Nil	36	72.0	72.0	72.0
	Hypertension	5	10.0	10.0	82.0
	DM	7	14.0	14.0	96.0
	Both	2	4.0	4.0	100.0
	Total	50	100.0	100.0	

In group A, 10% of patients had Hypertension, 14% had diabetes mellitus, and 4% had both diabetes mellitus and Hypertension (table-2).

TABLE-3: PREOP CREATININE-DESCRIPTIVE STATISTICS

	N	Minimum	Maximum	Mean	Std. Deviation
Pre op creatinine	50	.6	2.0	.908	.3200

In group A, the lowest creatinine was 0.6 and the highest creatinine was 2.0. Mean was 0.908 (table-3).

TABLE-4: ASSOCIATED STONE DISEASE – FREQUENCY TABLE

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Ureteric calculi	3	6.0	33.3	33.3
	Bilateral	3(6 renal units)	6.0	33.3	33.3
	Total	6	12.0	100.0	
Missing	System	41	82.0		
Total		50	100.0		

In group A, 6% of patients had ureteric calculi and 6% had bilateral stone disease (table-4).

TABLE-5: PUNCTURE SITE - FREQUENCY TABLE

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Inferior calyx	36	72.0	72.0	72.0
	Middle calyx	9	18.0	18.0	90.0
	Superior calyx	5	10.0	10.0	100.0
	Total	50	100.0	100.0	

In group A, 72% underwent inferior calyceal puncture, 18% underwent middle calyceal puncture and 10% underwent superior calyceal puncture (table-5).

GENDER OUTCOME

TABLE-6: GENDER DISTRIBUTION CROSSTABLE

			Group		Total	
			Group A	Group B		p-value
Sex	Male	Count	32	32	64	1.000
		% within Sex	50.0%	50.0%	100.0%	
		% within Group	64.0%	64.0%	64.0%	
	Female	Count	18	18	36	1.000
		% within Sex	50.0%	50.0%	100.0%	
		% within Group	36.0%	36.0%	36.0%	
Total		Count	50	50	100	
		% within Sex	50.0%	50.0%	100.0%	
		% within Group	100.0%	100.0%	100.0%	

(a) Computed only for a 2x2 table

(b) 0 cells (.0%) have expected count less than 5. The minimum expected count is 18.00.

In this study of 100 patients 64(64%) of them were males and 36 (36%) were females.

In group A, 32(64%) patients were males and 18(36%) patients were females. In group B, 32 (64%) patients were males and 18(36%) patients were females (table-6).

On statistical analysis using Chi-square test, it was found that the gender distribution between those of group A and group B was not statistically significant. (p= 1.000), (table- 6).

FIGURE-01: GENDER DISTRIBUTION

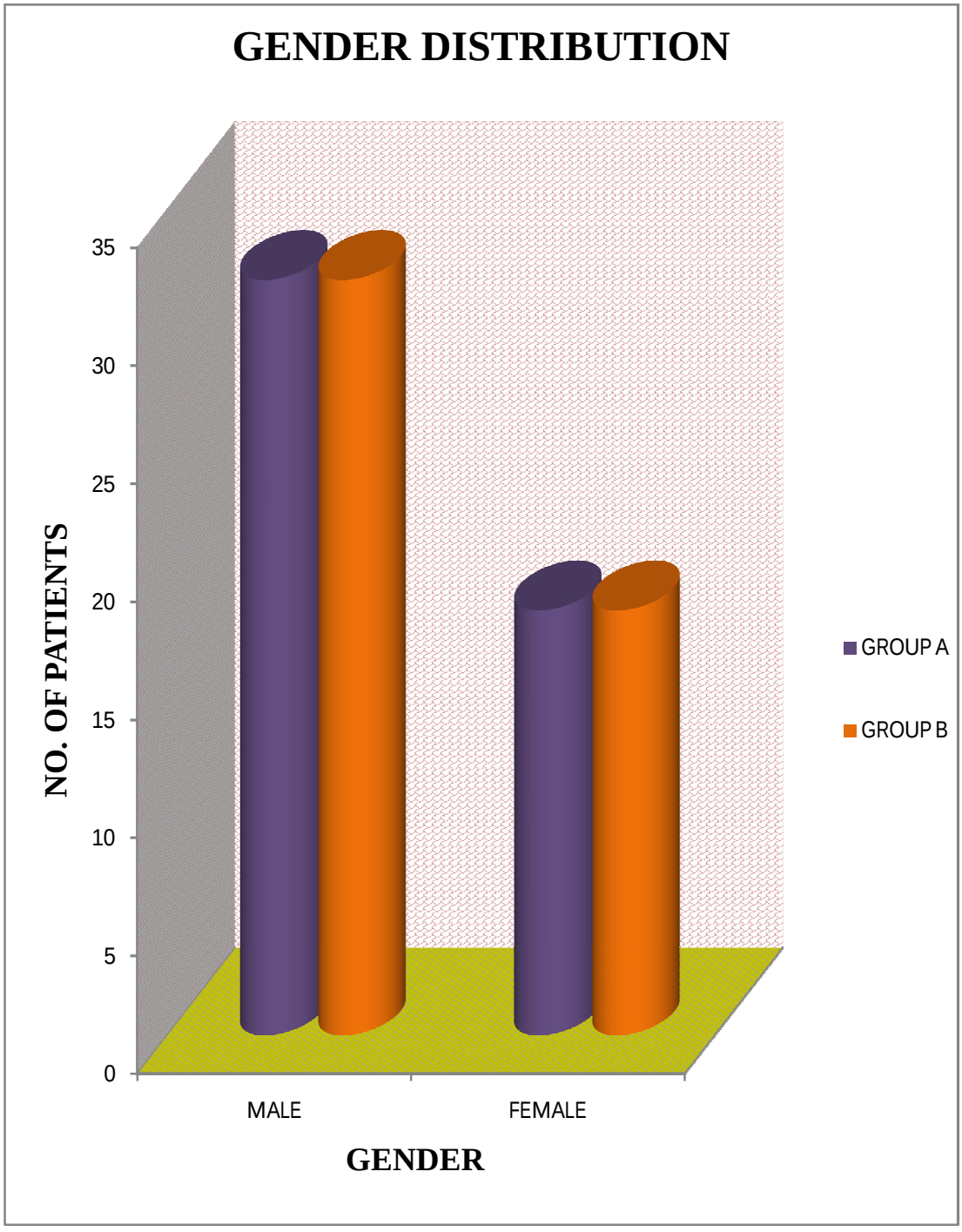


TABLE-7: LATERALITY DISTRIBUTION CROSSTABLE

			Group		Total
			Group A	Group B	
Side	Left	Count	26	21	47
		% within Side	55.3%	44.7%	100.0%
		% within Group	52.0%	42.0%	47.0%
	Right	Count	24	29	53
		% within Side	45.3%	54.7%	100.0%
		% within Group	48.0%	58.0%	53.0%
Total		Count	50	50	100
		% within Side	50.0%	50.0%	100.0%
		% within Group	100.0%	100.0%	100.0%

In this study, 47(47%) patients had stone on the left side and 53(53%) patients had stone on the right side.

In group A, 26(52%) patients had stone on the left side and 24(48%) patient had stone on the right side. In group B, 21(42%) patients had stone on the left side and 29(58%) patients had stone on the right side.(table-7)

TAB-8: LATERALITY DISTRIBUTION ANALYSIS CHI-SQUARE TESTS

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.004 (b)	1	.316		
Continuity Correction(a)	.642	1	.423		
Likelihood Ratio	1.005	1	.316		
Fisher's Exact Test				.423	.212
Linear-by-Linear Association	.994	1	.319		
No of Valid Cases	100				

(a) Computed only for a 2x2 table

(b) 0 cells (.0%) have expected count less than 5. The minimum expected count is 23.50.

On statistical analysis using Chi-square test, it was found that the laterality between those of group A and group B was not statistically significant (p= 0.423), (table- 8).

FIGURE–02: LATERALITY DISTRIBUTION

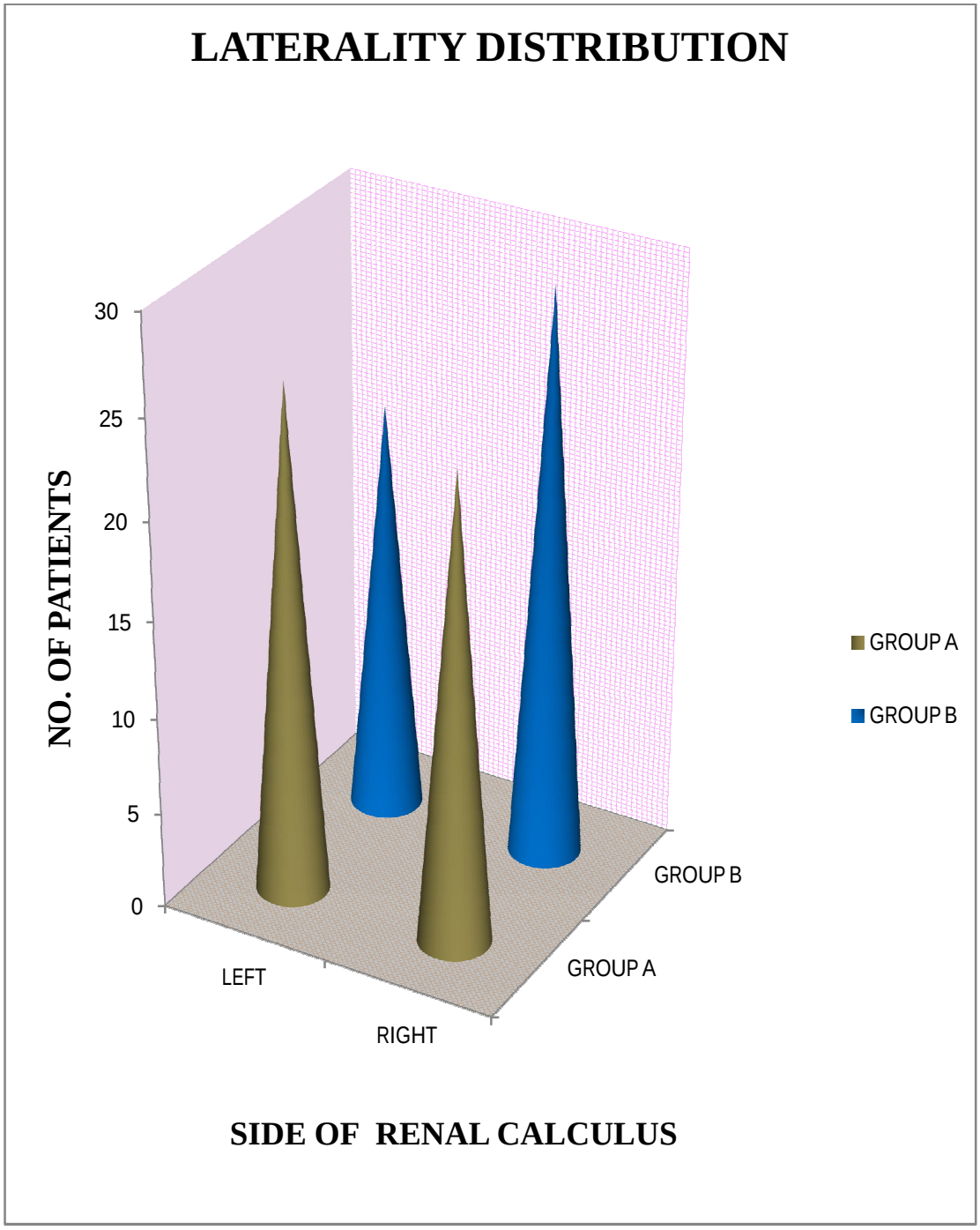


TABLE-9: COMORBIDITY DISTRIBUTION CROSSTABLE

			Group		Total
			Group A	Group B	
Comorbidity	Nil	Count	36	35	71
		% within Comorbidity	50.7%	49.3%	100.0%
		% within Group	72.0%	70.0%	71.0%
	Hypertension	Count	5	4	9
		% within Comorbidity	55.6%	44.4%	100.0%
		% within Group	10.0%	8.0%	9.0%
	Diabetes Mellitus	Count	7	9	16
		% within Comorbidity	43.8%	56.3%	100.0%
		% within Group	14.0%	18.0%	16.0%
	Both	Count	2	2	4
		% within Comorbidity	50.0%	50.0%	100.0%
		% within Group	4.0%	4.0%	4.0%
Total		Count	50	50	100
		% within Comorbidity	50.0%	50.0%	100.0%
		% within Group	100.0%	100.0%	100.0%

In this study 16(16%) patients had diabetes mellitus, 9(9%) had hypertension and 4(4%) patients had both diseases.

Among the group A patients, 7(14%) patients had diabetes

mellitus, 5(5%) had hypertension and 2(4%) had both. Among the group B patients, 9(18%) patients had diabetes mellitus, 4(8%) had hypertension and 2(4%) had both. (table- 9).

TABLE-10: COMORBIDITY DISTRIBUTION ANALYSIS

CHI-SQUARE TESTS

	Value	**Df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	.375(a)	3	.945
Likelihood Ratio	.376	3	.945
Linear-by-Linear Association	.110	1	.740
No of Valid Cases	100		

(a) 4 cells (50.0%) have expected count less than 5. The minimum expected count is 2.00.

On statistical analysis using Chi-square test, it was found that the comorbidity between those of group A and group B was not statistically significant (p= 0.945) (table-10).

FIGURE -03: COMORBIDITY

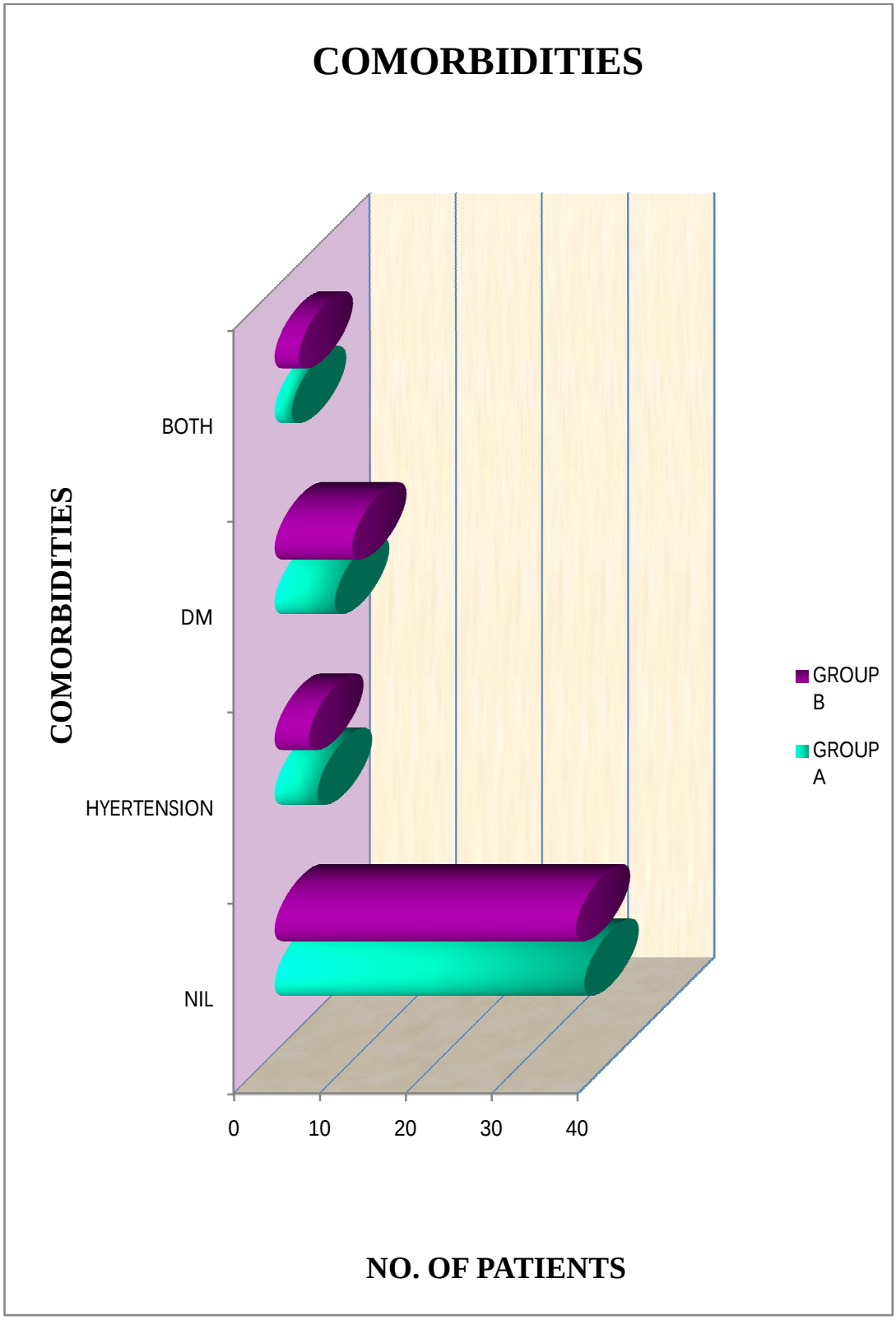


TABLE-11: PUNCTURE SITE DISTRIBUTION CROSSTABLE

			Group		Total
			Group A	Group B	
Puncture site	Inferior calyx	Count	36	38	74
		% within Puncture site	48.6%	51.4%	100.0%
		% within Group	72.0%	76.0%	74.0%
	Middle calyx	Count	9	8	17
		% within Puncture site	52.9%	47.1%	100.0%
		% within Group	18.0%	16.0%	17.0%
	Superior calyx	Count	5	4	9
		% within Puncture site	55.6%	44.4%	100.0%
		% within Group	10.0%	8.0%	9.0%
Total		Count	50	50	100
		% within Puncture site	50.0%	50.0%	100.0%
		% within Group	100.0%	100.0%	100.0%

In this study, 74 (74%) patients underwent lower calyceal puncture, 17 (17%) patients underwent middle calyceal puncture and 9(9%) underwent upper calyceal puncture.

In group A, 36(72%) patients underwent lower calyceal puncture, 9(18%) patients underwent middle calyceal puncture and 5(10%) underwent upper calyceal puncture. In group B, 38(76%) patients underwent lower calyceal puncture, 8(16%) patients underwent middle calyceal puncture and 4(8%) underwent upper calyceal puncture (table-11).

TABLE-12: PUNCTURE SITE DISTRIBUTION ANALYSIS

CHI-SQUARE TESTS

	Value	**Df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	.224(a)	2	.894
Likelihood Ratio	.224	2	.894
Linear-by-Linear Association	.219	1	.640
No of Valid Cases	100		

(a) 2 cells (33.3%) have expected count less than 5. The minimum expected count is 4.50.

On statistical analysis using Chi-square test, it was found that the puncture site between those of group A and group B was not statistically significant (p= 0.894) (table- 12).

FIGURE-04: PUNCTURE SITE DISTRIBUTION

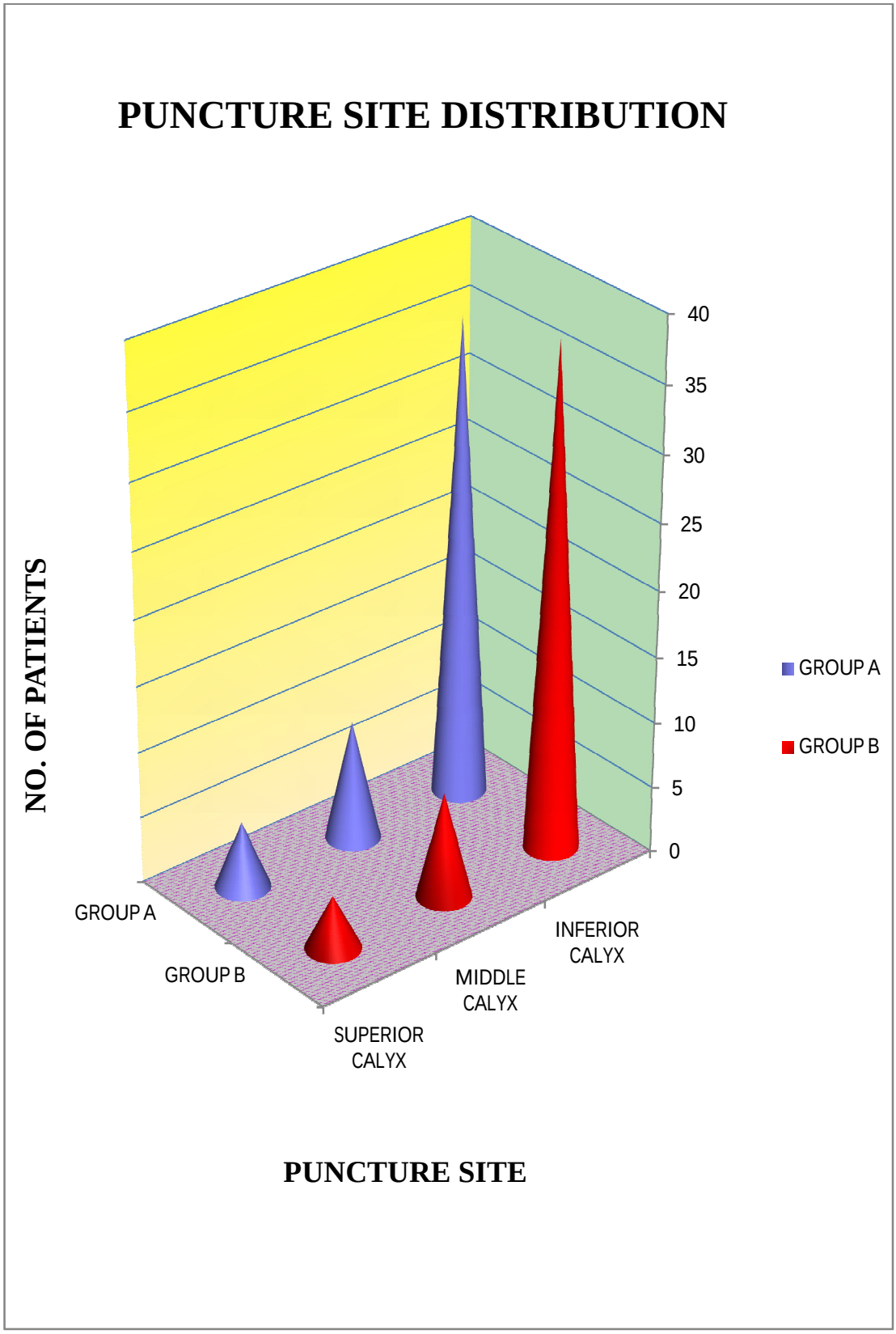


TABLE-13: COMPLICATIONS DISTRIBUTION CROSSTABLE

			Group		Total
			Group A	Group B	
Complications	No complications	Count	44	43	87
		% within Complications	50.6%	49.4%	100.0%
		% within Group	88.0%	86.0%	87.0%
	Hematuria	Count	1	2	3
		% within Complications	33.3%	66.7%	100.0%
		% within Group	2.0%	4.0%	3.0%
	Urosepsis	Count	5	5	10
		% within Complications	50.0%	50.0%	100.0%
		% within Group	10.0%	10.0%	10.0%
Total		Count	50	50	100
		% within Complications	50.0%	50.0%	100.0%
		% within Group	100.0%	100.0%	100.0%

In this study, 3(3%) patients developed hematuria and 10(10%) patients developed urosepsis.

Among those in group A, 1(2%) patient had hematuria and 5(10%) patients had urosepsis. In group B, 2(4%) patients had hematuria and 5(10%) patients had urosepsis (table-13). All these patients were managed conservatively. One patient in group A had urosepsis with PCS dilatation and underwent PCN (table-13).

TABLE- 14: COMPLICATIONS DISTRIBUTION ANALYSIS

CHI-SQUARE TESTS

	Value	**Df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	.345(a)	2	.842
Likelihood Ratio	.351	2	.839
Linear-by-Linear Association	.026	1	.871
No of Valid Cases	100		

(a) 2 cells (33.3%) have expected count less than 5. The minimum expected count is 1.50.

On statistical analysis using Chi-square test, it was found that the complication rate between those of group A and group B was not statistically significant (p= 0.842)(table-14).

FIGURE-05: COMPLICATIONS

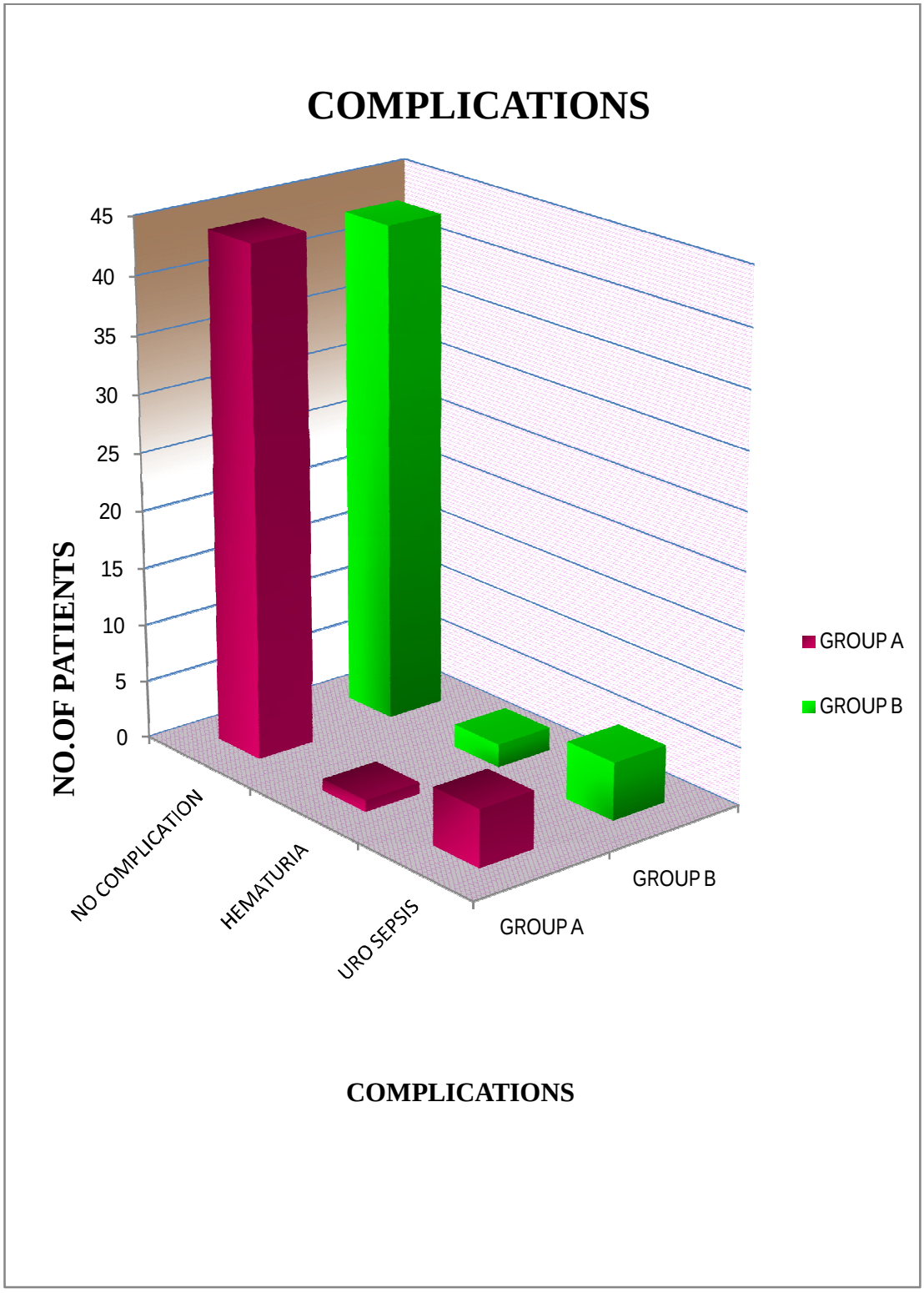


TABLE- 15: COMPLICATIONS

Comorbidity				Group		Total	p-value
				Group A	Group B		
Nil	Complication	No complication	Count	33	35	68	0.218
			% within Complication	48.5%	51.5%	100.0%	
			% within Group	91.7%	100.0%	95.8%	
		Bleeding	Count	1	0	1	
			% within Complication	100.0%	.0%	100.0%	
			% within Group	2.8%	.0%	1.4%	
		Uro sepsis	Count	2	0	2	
			% within Complication	100.0%	.0%	100.0%	
			% within Group	5.6%	.0%	2.8%	
	Total		Count	36	35	71	
			% within Complication	50.7%	49.3%	100.0%	
			% within Group	100.0%	100.0%	100.0%	
Hypertension	Complication	No complication	Count	4	2	6	0.455
			% within Complication	66.7%	33.3%	100.0%	
			% within Group	80.0%	50.0%	66.7%	
		Bleeding	Count	0	1	1	
			% within Complication	.0%	100.0%	100.0%	
			% within Group	.0%	25.0%	11.1%	
		Uro sepsis	Count	1	1	2	

			% within Complication	50.0%	50.0%	100.0%	
			% within Group	20.0%	25.0%	22.2%	
	Total		Count	5	4	9	
			% within Complication	55.6%	44.4%	100.0%	
			% within Group	100.0%	100.0%	100.0%	
DM	Complication	No complication	Count	6	6	12	0.383
			% within Complication	50.0%	50.0%	100.0%	
			% within Group	85.7%	66.7%	75.0%	
		Uro sepsis	Count	1	3	4	
			% within Complication	25.0%	75.0%	100.0%	
			% within Group	14.3%	33.3%	25.0%	
	Total		Count	7	9	16	
			% within Complication	43.8%	56.3%	100.0%	
			% within Group	100.0%	100.0%	100.0%	
Both	Complication	No complication	Count	1	0	1	0.368
			% within Complication	100.0%	.0%	100.0%	
			% within Group	50.0%	.0%	25.0%	
		Bleeding	Count	0	1	1	
			% within Complication	.0%	100.0%	100.0%	
			% within Group	.0%	50.0%	25.0%	
		Uro sepsis	Count	1	1	2	
			% within Complicati	50.0%	50.0%	100.0%	

			on				
			% within Group	50.0%	50.0%	50.0%	
	Total		Count	2	2	4	
			% within Complication	50.0%	50.0%	100.0 %	
			% within Group	100.0 %	100.0 %	100.0 %	

In this study there is no difference between complication rate in patients with comorbidity between two groups**.(**tab-15)

TABLE-16: STONE CLEARANCE DISTRIBUTION

CROSSTABLE

			Group		
			Group A	Group B	Total
Stone clearance	Complete	Count	48	47	95
		% within Stone clearance	50.5%	49.5%	100.0%
		% within Group	96.0%	94.0%	95.0%
	Incomplete	Count	2	3	5
		% within Stone clearance	40.0%	60.0%	100.0%
		% within Group	4.0%	6.0%	5.0%
Total		Count	50	50	100
		% within Stone clearance	50.0%	50.0%	100.0%
		% within Group	100.0%	100.0%	100.0%

In this study, 94(94%) patients had complete stone clearance.

Among group A patients, 48(96%) had complete stone clearance.

Among group B patients, 46(94%) had complete stone clearance (table-16).

TAB-17: STONE CLEARANCE RATE ANALYSIS CHI-SQUARE TESTS

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.211(b)	1	.646		
Continuity Correction(a)	.000	1	1.000		
Likelihood Ratio	.212	1	.645		
Fisher's Exact Test				1.000	.500
Linear-by-Linear Association	.208	1	.648		
N of Valid Cases	100				

(a) Computed only for a 2x2 table

(b) 2 cells (50.0%) have expected count less than 5. The minimum expected count is 3.00.

On statistical analysis using Chi-square test it was found that the stone clearance between those of group A and group B was not statistically significant (p= 0.845)(table- 17).

FIGURE-6: STONE CLEARANCE RATE

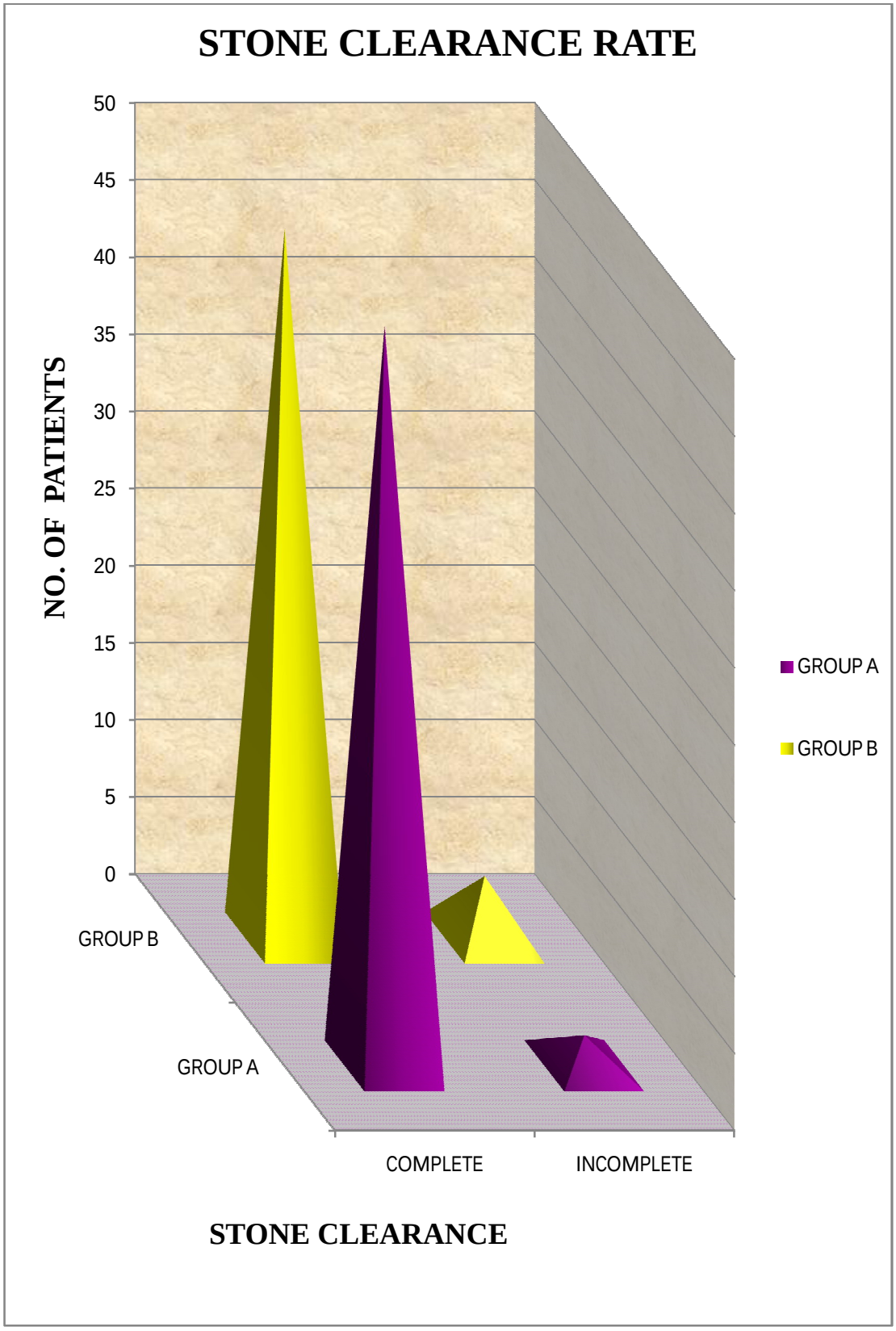


TABLE-18: ANCILLARY PROCEDURE DISTRIBUTION CROSSTABLE

			Group		Total
			Group A	Group B	
Ancillary procedure	Nil	Count	44	43	87
		% within Ancillary procedure	50.6%	49.4%	100.0%
		% within Group	88.0%	86.0%	87.0%
	L URS	Count	1	2	3
		% within Ancillary procedure	33.3%	66.7%	100.0%
		% within Group	2.0%	4.0%	3.0%
	R URS	Count	2	3	5
		% within Ancillary procedure	40.0%	60.0%	100.0%
		% within Group	4.0%	6.0%	5.0%
	ESWL	Count	2	2	4
		% within Ancillary procedure	50.0%	50.0%	100.0%
		% within Group	4.0%	4.0%	4.0%
	PCN	Count	1	0	1
		% within Ancillary procedure	100.0%	.0%	100.0%
		% within Group	2.0%	.0%	1.0%
Total		Count	50	50	100
		% within Ancillary procedure	50.0%	50.0%	100.0%
		% within Group	100.0%	100.0%	100.0%

In this study, 3(3%) patients required LT URS for left ureteric calculus, 5(5%) patients required RT URS, 4 (4%) patient needed ESWL and 1(1%) patient underwent PCN.

In group A, 1(2%) patient required LT URS for left ureteric calculus, 2(4%) patients required RT URS, 2(4%) patients needed ESWL and 1(2%) patient underwent PCN. In group B, 2(4%) patients required LT URS for left ureteric calculus, 3(6%) patients required RT URS, 2(4%) patient needed ESWL and no patient underwent PCN (table-18).

TABLE-19: ANCILLARY PROCEDURE DISTRIBUTION

ANALYSIS CHI-SQUARE TESTS

	Value	**df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	1.545(a)	4	.819
Likelihood Ratio	1.939	4	.747
Linear-by-Linear Association	.015	1	.903
No of Valid Cases	100		

(a) 8 cells (80.0%) have expected count less than 5. The minimum expected count is .50.

On statistical analysis using Chi-square test, it was found that the number of ancillary procedures done between those of group A and group B was not statistically significant (table-19).

FIGURE-7: ANCILLARY PROCEDURE

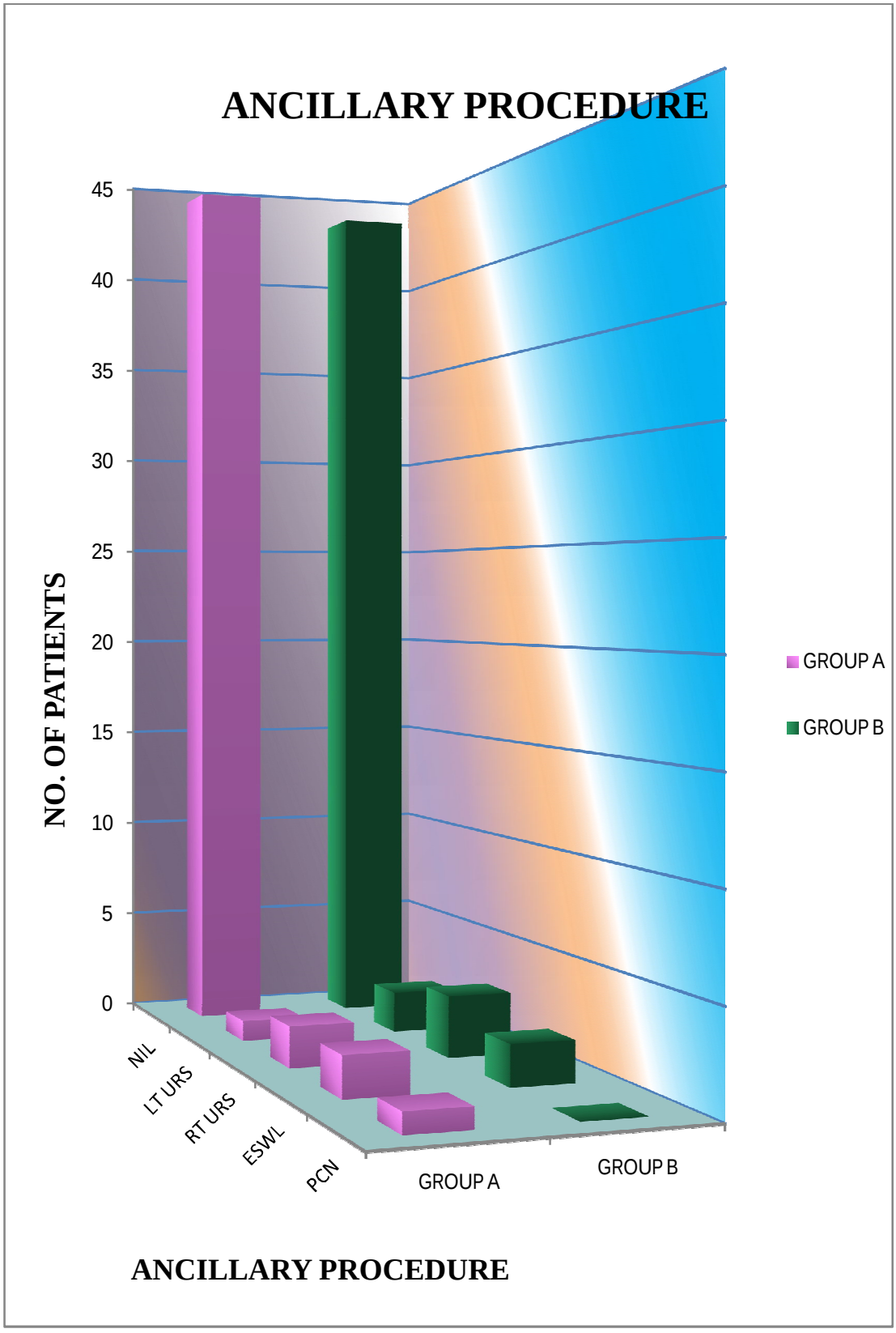


TABLE-20: T-TEST-GROUP STATISTICS

	Group	N	Mean	Std. Deviation	Std. Error Mean	p-value
Age in years	Group A	50	37.78	12.671	1.792	0.409
	Group B	50	39.86	12.400	1.754	
Stone size	Group A	50	2.998	.4649	.0657	0.333
	Group B	50	3.088	.4605	.0651	
Operation time	Group A	50	54.94	4.766	.674	0.693
	Group B	50	54.62	3.162	.447	
Drop in HB	Group A	50	.744	.2589	.0366	0.777
	Group B	50	.760	.3030	.0429	
No. of blood transfusion	Group A	50	.10	.303	.043	0.448
	Group B	50	.16	.468	.066	
Analgesic requirement	Group A	50	121.00	30.456	4.307	0.000
	Group B	50	170.00	31.944	4.518	
Hospital stay	Group A	50	3.32	.768	.109	0.000
	Group B	50	4.16	.422	.060	
Pre op creatinine	Group A	50	.908	.3200	.0453	0.847
	Group B	50	.920	.3003	.0425	

In this study, average age in group A was 37.78 yrs and group B's

average age was 39.89 yrs.

Group A’s average stone size was 2.998 cm and group B’s average stone size was 3.088 cm.

Group A’s average operation time was 54.94 min and group B’s average operation time was 54.62 min.

Group A’s average drop in HB was 0.744 g% and group B’s average drop in HB was 0.760 g%.

In group A, 10% of patients required blood transfusion and in group B, 16% of patients needed blood transfusion.

In group A, the average amount of analgesic requirement was 121mg of tramadol and in group B, the average amount of analgesic requirement was 170mg of tramadol.

Average no. of days of hospital stay for group A was 3.32 days and for group B, the average no. of days of hospital stay was 4.16 days

In group A, the average preop creatinine value was 0.908 mg/dl and in group B, the average preop creatinine value was 0.920 mg/dl (table-20).

On statistical analysis,

1. Age of the patient between those of group A and group B was not statistically significant (P-0.409) (table-20).
2. Stone size between those of group A and group B was not

statistically significant (P-0.333) (table-20).

3. Operation time between those of group A and group B was not statistically significant (P-0.693) (table-20).
4. Drop in HB between those of group A and group B was not statistically significant (P-0.777) (table-20).
5. Blood transfusion rate between those of group A and group B was not statistically significant (P<0.001) (table-20).
6. Analgesic requirement between those of group A and group B was not statistically significant (P<0.001) (table-20).
7. Preop creatinine between those of group A and group B was not statistically significant (P-0.847) (table-20).

DISCUSSION

Renal stone disease is one of the most common urological problems. Medical management may not be feasible in all circumstances. Surgical management is more effective in treatment of stone disease. Furthermore medical management is more helpful in preventing recurrences following surgical removal rather than as primary therapy.

Surgical management as previously explained comprises both open and endourological procedures. In the contemporary age renal calculus surgery is always done through minimal access procedures.Over a period, PCNL has developed to be a safer and relatively less morbid procedure when compared to an open stone surgery. Due to its lesser cost, shorter operative time, minimal requirement for blood transfusion and analgesics and ability of the patients to regain their routine daily life activities sooner make PCNL the preferred procedure at recent times.

The procedure when attempted initially was time consuming, tedious for both patient and treating surgeon and with considerable morbidity and some mortality.

Because of technical improvements in imaging and optics and with better understanding of the pathology behind the significant morbidity, the procedure has been standardized.

To begin with, gaining an access was believed to be a crucial step in the success of the procedure. With an excellent preoperative imaging provided by the reconstructed computerised tomography nowadays, localization and delineation of the extent of calculi is far better. Excellent demarcation of pelvicalyceal anatomy has facilitated in gaining an easier access to the pelvicalyceal system. Furthermore technical advancements like fluoroscopic and ultrasonographic guided attempts to gain an access helped out in effectively creating a tract into the pelvicalyceal system. As already mentioned there are antegrade and retrograde techniques of access into the pelvicalyceal system but still the most preferred route is the antegrade access.

Surgical skills in PCNL improved a lot during the years and the procedure has become more perfect, meaning that the tract made is just sufficient for the procedure to be done and unnecessary tissue handling is avoided. This is an important step in the increase in success rates of the procedure in recent years.

Dilatation of the tract is accomplished by various types of dilators like coaxial Alken dilators, Amplatz semirigid dilators and balloon dilators. All these dilators have aided in establishing a successful tract.

Improvements in optics and miniaturization of endo instruments have also lessened the morbidity rates and thus increased the success rate. With the introduction of flexible instruments, we have a better access to all parts of the collecting system without a necessity for additional tracts.

Improvements in intracorporeal lithotripters have also increased the success rate of percutaneous nephrolithotomy. Smaller sized lithotripter probes and effective retrieval of stone fragments have enhanced the outcome of the procedure.

Despite the advancements and subsequent perfections, a few morbidities continue to affect the patients. Nephrostomy tube kept after the procedure adds to the patient's discomfort.

In our study we compared tubeless PCNL vs standard PCNL in patients with stone disease.

Tubeless PCNL was performed with success in patients of age 13 yrs to 65yrs.

Tubeless PCNL was done even in patients with elevated renal parameters as 5(10%) patients in group A had elevated renal parameters. The highest creatinine value in group A is 2mg/dl.

Tubeless PCNL was safely done even in patients with DM, HTN as 5(10%) patients had HTN and 7(14%) patients had DM and 2(4%) had both in tubeless PCNL group.

Tubeless PCNL was done in patients with stone disease irrespective of tract location (upper, middle or lower).

In tubeless PCNL group 3(6%) of the patients had B/L stone disease and underwent B/L tubeless PCNL in two sittings.

3(6%) patients had associated ureteric calculi and underwent URS and PCNL in the same sitting.

Operative time in both the groups was similar.(GROUP A 54.92 Minvs GROUP B 54.62 Min).

The postoperative drop in HB and blood transfusion rate was similar in both groups under study.

Presence of residual calculi was similar in both the groups and these residual calculi were treated with ESWL.

The need for post op analgesia was less with tubeless PCNL group.The Group A patients needed 121 mg OF Tramadol whereas Group B needed 170mg. This is statistically significant with a p value of<0.001.

A study conducted by both Madhu S. Agrawal etal & B.Lojanapiwat et al showed similar results.

Post op complications were similar in both groups. Postop complications in both the groups were managed conservatively .But one patient from group A developed urosepsis with PCS dilatation. This patient underwent PCN.

Length of Postoperative hospital stay was longer in standard PCNL group (4.16 days) compared to the tubeless PCNL group(3.32 days).This is statistically significant with a p value of <0.001.

Studies conducted by Madhu S. Agrawalet al,B.Lojanapiwat et al,Hemendra Shah et al also showed similar results.

CONCLUSION

Tubeless PCNL is a relative safe procedure even in patients with elevated renal parameters and in those with associated comorbid conditions.

Tubeless PCNL is safe in any tract location (upper, middle, lower).

. Tubeless PCNL can be safely done even in patients with bilateral disease.

Tubeless PCNL requires less analgesics and less hospital stay.

Both standard and tubeless PCNL have similar post op complication rate.

Tubeless PCNL is a very safe and very effective procedure if done in selected group of patients.

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APPENDIX 1

INFORMED CONSENT FORM

Title of the study: A COMPARATIVE STUDY OF STANDARD VERSUS TUBELESS PERCUTANEOUS NEPHROLITHOTOMY

Name of the Participant:

Name of the Principal Investigator: Dr. NAVEEN.S

Name of the Institution:

Madras Medical College and Rajiv Gandhi Government General Hospital,

Chennai- 3

Name and address of the sponsor / agency: Nil

Documentation of the informed consent

I have read the information in this form (or it has been read to me). I was free to ask any questions and they have been answered. I am over 18 years of age and, exercising my free power of choice, hereby give my consent to be included as a participant in **—A COMPARATIVE STUDY OF STANDARD VERSUS TUBELESS PERCUTANEOUS NEPHROLITHOTOMY**

1. I have read and understood this consent form and the information provided to me.

2. I have had the consent document explained to me.

3. I have been explained about the nature of the study.

4. I have been explained about my rights and responsibilities by the investigator.

5. I have been informed the investigator of all the treatments I am taking or have taken in the past ____ months including any native (alternative) treatment.

6. I have been advised about the risks associated with my participation in this study.

7. I agree to cooperate with the investigator and I will inform him/her immediately if I suffer unusual symptoms.

8. I have not participated in any research study within the past _____month(s).

9. I am aware of the fact that I can opt out of the study at any time without having to give any reason and this will not affect my future treatment in this hospital.

10. I am also aware that the investigator may terminate my participation in the study at any time, for any reason, without my consent.

11. I hereby give permission to the investigators to release the information obtained from me as result of participation in this study to the sponsors, regulatory authorities, government agencies, and IEC. I understand that they are publicly presented.

12. I have understood that my identity will be kept confidential if my data are publicly presented.

13. I have had my questions answered to my satisfaction.

14. I have decided to be in the research study. I am aware that if I have any question during this study, I should contact the investigator. By signing this consent form I attest that the information given in this

document has been clearly explained to me and understood by me, I will be given a copy of this consent document. For adult participants:

Name and signature / thumb impression of the participant

Name _____ Signature_____

Date_____

Name and Signature of impartial witness(for illiterate patients):

Name_____ Signature_____

Date_____

Address and contact number of the impartial witness:

Name and Signature of the investigator or his representative obtaining consent:

Name_____ Signature_____

Date_____

For Children being enrolled in research:

Whether child‘s assent was asked: Yes / No (Tick one)

[If the answer to be above question is yes, write the following phrase:

You agree with the manner in which assent was asked for from your child and given by your child. You agree to have your child take part in this study].

[If answer to be above question No, give reason (s)

_____

Although your child did not or could not give his or her assent, you agree to your child‘s participation in this study.

Name and Signature of / thumb impression of the participant‘s parent(s) (or legal representative)

Name_____ Signature_____

Date_____

Name_____ Signature_____

Date_____

Name and Signature of impartial witness (required for parents of participant child illiterate):

Name_____ Signature_____

Date_____

Address and contact number of the impartial witness:

_____

Name and Signature of the investigator or his representative obtaining consent :

Name_____ Signature_____

Date----------

ஆராய்ச்சி ஒப்புதல் படிவம்

ஆராய்ச்சி தலைப்பு

"சிறுநீரகத்தில் குழாய் வைத்து அல்லது வைக்காமல் செய்யப்படும் தோல்வழி சிறுநீரக கல் அகற்றும் அறுவை சிகிச்சையை ஒப்பிட்டு பார்க்கும் ஆய்வு"

ஆராய்ச்சி நிலையம் : சிறுநீரியல் துறை,
சென்னை மருத்துவக் கல்லூரி மற்றும்
ராஜீவ் காந்தி அரசு பொது மருத்துவமனை, சென்னை.

பங்கு பெறுவரின் பெயர் :

பாலினம் :

பங்குபெறபவரின் எண் :

பங்கு பெறுபவர் இதனை (✓) குறிக்கவும்

மேலே குறிப்பிட்டுள்ள மருத்துவ ஆய்வின் விவரங்கள் எனக்கு விளக்கப்பட்டது. என்னுடைய சந்தேகங்களை கேட்கவும், அதற்கான தகுந்த விளக்கங்களை பெறவும் வாய்ப்பளிக்கப்பட்டது. ☐

நான் இவ்வாய்வில் தன்னிச்சையாகதான் பங்கேற்கிறேன். எந்த காரணத்தினாலோ எந்த கட்டத்திலும் எந்த சட்ட சிக்கலுக்கும் உட்படாமல் நான் இவ்வாய்வில் இருந்து விலகி கொள்ளலாம் என்றும் அறிந்து கொண்டேன். ☐

இந்த ஆய்வு சம்பந்தமாகவோ, இதை சார்ந்த மேலும் ஆய்வு மேற்கொள்ளும் போதும் இந்த ஆய்வில் பங்குபெறும் மருத்துவர் என்னுடைய மருத்துவ அறிக்கைகளை பார்ப்பதற்கு என் அனுமதி தேவையில்லை என அறிந்து கொள்கிறேன். நான் ஆய்வில் இருந்து விலகிக் கொண்டாலும் இது பொருந்தும் என அறிகிறேன். ☐

இந்த ஆய்வின் மூலம் கிடைக்கும் தகவல்களையும், பரிசோதனை முடிவுகளையும் மற்றும் சிகிச்சை தொடர்பான தகவல்களையும் மருத்துவர் மேற்கொள்ளும் ஆய்வில் பயன்படுத்திக்கொள்ளவும் அதை பிரசுரிக்கவும் என் முழு மனதுடன் சம்மதிக்கின்றேன். ☐

இந்த ஆய்வில் பங்கு கொள்ள ஒப்புக்கொள்கிறேன். எனக்கு கொடுக்கப்பட்ட அறிவுரைகளின்படி நடந்து கொள்வதுடன் இந்த ஆய்வை மேற்கொள்ளும் மருத்துவ அணிக்கு உண்மையுடன் இருப்பேன் என்று உறுதியளிகிறேன். எனது உடல் நலம்பாதிக்கப்பட்டாலோ அல்லது எதிர்பாராத வழக்கதிற்கு மாறான நோய்க்குறி தென்பட்டாலோ உடனே அதை மருத்து அணியிடம் தெரிவிப்பேன் என உறுதி அளிக்கிறேன். ☐

இந்த ஆய்வில் எனக்கு இரத்தம், சிறுநீர், எக்ஸ்ரே, ஸ்கேன் செய்துகொள்ள நான் முழு மனதுடன் சம்மதிக்கிறேன். ☐

பங்கேற்பவரின் கையொப்பம் ..... இடம்..... தேதி.....

கட்டைவிரல் ரேகை

பங்கேற்பவரின் பெயர் மற்றும் விலாசம் .....

ஆய்வாளரின் கையொப்பம் ..... இடம்..... தேதி.....

ஆய்வாளரின் பெயர் .....

தகவல் படிவம்

ஆய்வு செய்யப்படும் தலைப்பு

"சிறுநீரகத்தில் குழாய் வைத்து அல்லது வைக்காமல் செய்யப்படும் தோல்வழி சிறுநீரக கல் அகற்றும் அறுவை சிகிச்சையை ஒப்பிட்டு பார்க்கும் ஆய்வு"

ஆய்வாளரின் பெயர் :
பங்கேற்பாளரின் பெயர் :
ஆராய்ச்சி நிலையம் : சிறுநீரியல் துறை,
சென்னை மருத்துவக் கல்லூரி மற்றும்
ராஜீவ் காந்தி அரசு பொது மருத்துவமனை, சென்னை.

தங்களுக்கு சிறுநீரகத்தில் கல் ஏற்பட்டுள்ளது. அறுவை சிகிச்சையின் மூலம் கல் அகற்ற வேண்டி உள்ளது. தோல்வழி சிறுநீர் கல் அகற்று சிகிச்சை செய்யப்படுகிறது. கல் அகற்றிய பின் சிறுநீரகத்தில் குழாய் வைத்து அல்லது வைக்காமல் அறுவை சிகிச்சை செய்ய முடியும். சிறுநீரகத்தில் குழாய் வைத்து அல்லது வைக்காமல் தோல்வழி சிறுநீரக கல் அகற்றும் அறுவை சிகிச்சை செய்து கொள்ள சம்மதிக்கிறேன்.

முடிவுகளை அல்லது கருத்துகளை வெளியிடும்போதோ அல்லது ஆராய்ச்சியின் போதோ தங்களது பெயரையோ அல்லது அடையாளங்களையோ வெளியிடமாட்டோம் என்பதையும் தெரிவித்துக் கொள்கிறோம்.

இந்த ஆய்வில் பங்குபெறுவது நோயாளிகளின் சொந்த விருப்பத்திலேயே ஆகும். இந்த ஆய்வையொட்டி எந்தவிதமான சந்தேகங்களுக்கும் விளக்கம் பெற நோயாளிகளுக்கு உரிமை உள்ளது. இந்த ஆய்வின் முடிவுகள் இறுதியில் பிரசுரிக்கப்படும்.

பங்கேற்பவரின் கையொப்பம் ..... இடம்..... தேதி.....

கட்டைவிரல் ரேகை

பங்கேற்பவரின் பெயர் மற்றும் விலாசம் .....

ஆய்வாளரின் கையொப்பம் ..... இடம்..... தேதி.....
ஆய்வாளரின் பெயர் .....

APPENDIX 2

PROFORMA

Name: Age: Sex:

Ip No:

Address:

Chief complaints:

Comorbidity

DM

HTN

ASTHMA

IHD

Past medical/surgical history

Examination

PR: BP:

R/S: CVS:

P/A:

EG:

CBC:

RFT:

X ray KUB:

USG KUB:

CECT KUB/IVP: Stone Size:

Intra op

Operation time: Puncture site:

Nephrostomy: Yes/No

Drop in HB: No of blood transfusion:

Anelgesia: Stone clearance:

Complication: Ancillary procedure:

No of days hospital stay:

APPENDIX 3

INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE, CHENNAI -3

Telephone No : 044 25305301
Fax : 044 25363970

CERTIFICATE OF APPROVAL

To
Dr.Naveen.S
Mch (Urology)PG,
MMC,Chennai-3.

Dear Dr.Naveen

The Institutional Ethics committee of Madras Medical College, reviewed and discussed your application for approval of the proposal entitled "A comparative study of standard vs Tubeless percutaneous nephrolithotomy" No.22042013.

The following members of Ethics Committee were present in the meeting held on 17.04.2013 conducted at Madras Medical College, Chennai -3.

1. Dr.G.SivaKumar, MS FICS FAIS --- Chairperson
2. Prof. Kalai Selvi MD -- Member Secretary
   Director, Instt. of Pharmacology ,MMC, Ch-3 (Incharge)
3. Prof. Shyamraj MD -- Member
   Director i/c , Instt. of Biochemistry , MMC, Ch-3
4. Prof. P. Karkuzhali. MD -- Member
   Prof., Instt. of Pathology, MMC, Ch-3
5. Prof. A. Radhakrishnan MD -- Member
   Prof of Internal Medicine, MMC, Ch-3
6. Prof. S. Deivanayagam MS -- Member
   Prof of Surgery, MMC, Ch-3
7. Thiru. S. Govindsamy. BABL -- Lawyer
8. Tmt. Arnold Saulina MA MSW -- Social Scientist

We approve the proposal conducted in its presented form.
Sd/ Chairman & Other Members

The Institutional Ethics Committee expects to be informed about the progress of the study, and SAE occurring in the course of the study, any changes in the protocol and patients information / informed consent and asks to be provided a copy of the final report.

Member Secretary, Ethics Committee

MEMBER SECRETARY
INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE
CHENNAI-600 003

APPENDIX 4

MASTER CHART

SERIAL NO	NAME	AGE (yrs)	SEX	GROUP	SIDE	STONE SIZE	COMORBIDITY	PUNCTURE SITE	OPERATION TIME(min)	DROP IN HB (g%)	NO. OF BLOOD TRANSFUSION	ANALGESIC REQUIREMENT (Tramadol)	HOSPITAL STAY (days)	COMPLICATIONS	STONE CLEARANCE	PRE OP CREATININE (mg/dl)	ANCILLARY PROCEDURE
1	Karunakaran	28y	M	A	R	2.5	NO	Inferior calyx	40	0.9	NIL	100mg	3	No	Complete	0.8	NO
2	Hemalatha	13y	F	A	L-R U	3	NO	Inferior calyx	53	1	1	100mg	3	No	Complete	0.7	R-URS
3	Thirumalaisamy	46y	M	A	L	2.9	NO	Inferior calyx	54	0.6	NIL	100mg	3	No	Complete	0.6	NO
4	Madhu	48y	F	A	R	3.3	DM	Inferior calyx	43	0.7	NIL	100mg	3	No	Complete	0.9	NO
5	Dhanalakshmi	45y	F	A	L	3.8	HTN	Inferior calyx	42	0.8	NIL	100mg	3	No	Complete	1	NO
6	Ramalingam	65y	M	A	R	3.5	DM/HTN	Inferior calyx	40	1	NIL	200mg	6	uro sepsis	Complete	1.8	NO
7	Latha	35y	F	A	R	3	NO	Inferior calyx	35	0.7	NIL	100mg	3	No	Complete	0.8	NO
8	Rajendran	44y	M	A	L	3.3	NO	Inferior calyx	37	0.8	NIL	150mg	5	bleeding	Complete	0.9	NO
9	Dhanalakshmi	55y	F	A	L	2.9	NO	Middle calyx	39	0.8	NIL	150mg	3	No	Complete	0.7	NO
10	Maryappan	45y	M	A	L	2.4	HTN	Inferior calyx	45	0.9	NIL	100mg	3	No	Complete	1	NO
11	Vijay kumar	28y	M	A	R-L U	3.7	NO	Inferior calyx	50	1.5	1	150mg	3	No	Complete	0.8	L-URS
12	Kaviyamuthan	30y	M	A	L	2.7	NO	Inferior calyx	49	0.6	NIL	100mg	3	No	Complete	0.7	NO
13	Mahendran	43y	M	A	L	2.9	NO	Inferior calyx	47	0.7	NIL	100mg	3	No	Complete	0.9	NO
14	Lakshmi	45y	F	A	L-B/L	3	NO	Middle calyx	50	0.9	NIL	100mg	3	No	Complete	0.6	NO
15	Vijay kumar	35y	M	A	R	3.3	NO	Middle calyx	47	0.5	NIL	150mg	3	No	Incomplete	0.8	ESWL

16	Mahesh	34y	M	A	L	3	NO	Superior calyx	41	0.3	NIL	200mg	4	uro sepsis	Complete	0.7	NO
17	Kalidoss	19y	M	A	R	2.7	NO	Inferior calyx	45	0.7	NIL	100mg	3	No	Complete	0.9	NO
18	Bharath	20y	M	A	R	2.9	NO	Inferior calyx	38	0.5	NIL	100mg	3	No	Complete	0.8	NO
19	Seetha	24y	F	A	L	3.1	NO	Inferior calyx	39	0.8	NIL	100mg	3	No	Complete	0.7	NO
20	Saroja	45y	F	A	R	3.2	DM	Middle calyx	40	0.6	NIL	150mg	5	uro sepsis	Complete	0.9	NO
21	Krisnaveni	40y	F	A	L	3.3	HTN	Superior calyx	44	0.4	NIL	100mg	3	No	Complete	1	NO
22	Lakshmi	45y	F	A	R-B/L	3.4	NO	Superior calyx	39	0.9	NIL	100mg	3	No	Complete	0.8	NO
23	Kannan	45y	M	A	R	2.1	DM	Inferior calyx	45	0.8	NIL	150mg	4	No	Complete	2	NO
24	Thenarasu	20 Y	M	A	R	3.7	NO	Inferior calyx	38	0.5	NIL	100mg	3	No	Incomplete	0.8	NO
25	Jennifer	24 Y	F	A	L-B/L	2.8	NO	Inferior calyx	46	0.7	NIL	100mg	3	No	Complete	0.9	NO
26	Thangarasu	28y	M	A	L	2.9	NO	Inferior calyx	52	0.8	NIL	100mg	3	No	Complete	0.7	NO
27	Arun kumar	23y	M	A	L	2.5	NO	Inferior calyx	53	0.3	NIL	150mg	3	No	Complete	0.9	NO
28	Vijay raj	43y	M	A	R-R VUJ	3	NO	Middle calyx	49	0.6	NIL	150mg	3	No	Complete	0.8	R-URS
29	Rajan	43y	M	A	R	3.2	DM	Inferior calyx	52	1.5	1	100mg	3	No	Complete	0.8	NO
30	Jennifer	24y	F	A	R-B/L	3.5	NO	Inferior calyx	56	0.5	NIL	150mg	3	No	Complete	0.9	NO
31	Erullappan	31y	M	A	L	3.6	NO	Inferior calyx	49	0.8	NIL	100mg	3	No	Complete	0.8	NO
32	Arun	23y	M	A	L	3.7	NO	Inferior calyx	50	0.7	NIL	150mg	3	No	Complete	0.7	NO
33	Poongodi	27y	M	A	R	2.9	NO	Superior calyx	48	0.9	NIL	100mg	3	No	Complete	0.6	NO
34	Devammal	45y	F	A	L-B/L	2.8	DM/HTN	Inferior calyx	47	0.6	NIL	100mg	4	No	Complete	0.9	NO
35	Tameem ansari	25y	M	A	R	2.7	NO	Inferior calyx	49	0.7	NIL	200mg	6	uro sepsis	Complete	1	PCN
36	Poongodai	29y	F	A	R	2.5	NO	Superior calyx	48	0.9	NIL	100mg	3	No	Complete	0.9	NO
37	Shiva nathan	61y	M	A	R	2.4	HTN	Inferior	53	0.8	NIL	150mg	5	uro sepsis	Complete	1.3	NO

								calyx									
38	Vijaya	46y	F	A	R	3.6	NO	Inferior calyx	55	0.6	NIL	100mg	3	No	Complete	1.8	NO
39	Palani	65y	M	A	L	2.9	NO	Inferior calyx	57	0.5	NIL	100mg	3	No	Complete	1.9	NO
40	Settu	45y	M	A	R	3.5	DM	Middle calyx	53	0.7	NIL	150mg	4	No	Complete	0.8	NO
41	Sakthi vel	23y	M	A	R	3.4	NO	Inferior calyx	48	0.6	NIL	100mg	3	No	Complete	0.7	NO
42	Chidambaram	25y	M	A	R	2.3	NO	Inferior calyx	47	0.8	NIL	100mg	3	No	Complete	0.6	NO
43	Paripooranam	47y	F	A	L	3.2	NO	Inferior calyx	46	0.7	NIL	100mg	3	No	Complete	0.9	NO
44	Thanika chalam	45y	M	A	R	3.3	HTN	Middle calyx	45	0.7	NIL	150mg	3	No	Complete	0.8	NO
45	Thirumurugan	35y	M	A	L	3.7	NO	Inferior calyx	49	0.8	NIL	100mg	3	No	Incomplete	0.7	ESWL
46	Thanika chalam	40 Y	M	A	L	2.5	NO	Inferior calyx	51	0.9	NIL	100mg	3	No	Complete	0.6	NO
47	Partheban	45y	M	A	L	2.4	DM	Inferior calyx	54	0.8	NIL	100mg	3	No	Complete	0.9	NO
48	Parama sivam	40 y	M	A	L	2.1	NO	Inferior calyx	56	0.4	NIL	150mg	3	No	Complete	0.8	NO
49	Kaliyyamma l	65y	F	A	L	2	DM	Middle calyx	53	0.3	NIL	100mg	3	No	Complete	1.1	NO
50	Devamani	45y	F	A	L-B/L	2.9	NO	Middle calyx	49	1.3	1	150mg	3	No	Complete	1	NO
51	Anbalagan	40y	M	B	R	2.8	NO	Inferior calyx	39	0.5	NIL	150mg	4	No	Complete	0.8	NO
52	Chidambaram	25 Y	M	B	L-R U	3	NO	Inferior calyx	45	0.6	NIL	150mg	4	No	Complete	0.7	R-URS
53	Maiyam beevi	50y	F	B	R	3.3	DM	Inferior calyx	57	0.7	NIL	200mg	5	uro sepsis	Complete	0.8	NO
54	Viji	30y	F	B	L	3.9	NO	Inferior calyx	55	0.8	NIL	150mg	4	No	Complete	0.9	NO
55	Govinda rajan	43y	M	B	R-L U	4	NO	Middle calyx	53	0.9	NIL	150mg	4	No	Complete	0.6	L-URS
56	Dayalan	43y	M	B	R	3.8	NO	Inferior calyx	54	0.8	NIL	150mg	4	No	Complete	0.9	NO
57	Syed	60y	M	B	R	3.6	DM/HTN	Inferior calyx	52	0.4	NIL	200mg	5	bleeding	Complete	2	NO
58	Agnesh	55y	M	B	L	3.6	NO	Inferior calyx	49	0.8	NIL	150mg	4	No	Complete	0.7	NO

59	Parameswari	49y	F	B	R	3.2	DM	Inferior calyx	47	0.9	NIL	150mg	4	No	Complete	0.8	NO
60	Raja mohamed	28y	M	B	R-RU	3	NO	Inferior calyx	45	0.3	NIL	150mg	4	No	Complete	0.9	R-URS
61	Ganesh	46y	M	B	R	2.9	NO	Middle calyx	49	1.5	2	150mg	4	No	Complete	0.8	NO
62	Murugan	30y	M	B	B/L-L U	3.3	NO	Inferior calyx	50	0.6	NIL	150mg	4	No	Incomplete	0.9	NO
63	Saratha	40y	F	B	R-L U	3.6	HTN	Inferior calyx	53	0.8	NIL	150mg	4	No	Complete	1.2	L-URS
64	Sarathamma l	47y	F	B	R	3.7	NO	Inferior calyx	52	0.7	NIL	150mg	4	No	Complete	1	NO
65	Nalini	24y	F	B	R	3.8	NO	Middle calyx	44	0.5	NIL	150mg	4	No	Complete	0.9	NO
66	Srinivasan	19y	M	B	L-R U	3.5	NO	Inferior calyx	45	0.7	NIL	150mg	4	No	Complete	0.8	R-URS
67	Vasudevan	45y	M	B	R	3.4	DM	Inferior calyx	46	0.8	NIL	250mg	5	uro sepsis	Complete	1.5	NO
68	Navneethu	39y	M	B	R	2.9	NO	Inferior calyx	59	0.5	NIL	200mg	4	No	Incomplete	0.6	ESWL
69	Natarajan	65y	M	B	L	2.3	HTN	Middle calyx	60	0.8	NIL	250mg	4	No	Complete	1.2	NO
70	Malliga	43y	F	B	L	2.2	NO	Inferior calyx	47	0.4	NIL	200mg	4	No	Complete	0.8	NO
71	Palani	40y	M	B	L	2.6	NO	Inferior calyx	46	0.8	NIL	200mg	4	No	Complete	0.7	NO
72	Ravi kumar	49y	M	B	L	2.7	DM	Superior calyx	45	0.9	NIL	150mg	4	No	Complete	0.9	NO
73	Praveen	29y	M	B	L	2.9	NO	Inferior calyx	53	0.6	NIL	150mg	4	No	Complete	0.7	NO
74	Dayalan	37y	M	B	R	3	NO	Inferior calyx	55	0.7	NIL	200mg	4	No	Complete	0.9	NO
75	Govindamm al	35y	F	B	L-B/L	2.2	NO	Inferior calyx	58	0.9	NIL	150mg	4	No	Complete	0.7	NO
76	Kowsalya	18y	F	B	L	2.8	NO	Superior calyx	59	0.5	NIL	150mg	4	No	Complete	0.8	NO
77	Sasikala	18y	F	B	L	3.1	NO	Inferior calyx	52	0.3	NIL	200mg	4	No	Incomplete	0.6	ESWL
78	Krisnaveni	60y	F	B	R	3.2	DM/HTN	Inferior calyx	51	0.8	NIL	250mg	6	uro sepsis	Complete	1.8	NO
79	Senbagavalli	21y	F	B	R	2.9	NO	Inferior calyx	49	0.8	NIL	200mg	4	No	Complete	0.8	NO
80	Murali	25y	M	B	R	3	NO	Middle	48	0.9	NIL	150mg	4	No	Complete	0.7	NO

								calyx									
81	Shymala	21y	M	B	L	2.7	NO	Inferior calyx	44	1.5	1	150mg	4	No	Complete	0.9	NO
82	Prabagaran	36y	M	B	R	2.9	NO	Inferior calyx	42	0.6	NIL	150mg	4	No	Complete	1	NO
83	Subramani	33y	M	B	L-B/L	2.7	NO	Inferior calyx	41	0.4	NIL	150mg	4	No	Complete	0.8	NO
84	Palani	45y	M	B	R	2.8	NO	Superior calyx	40	1.4	1	150mg	4	No	Complete	0.9	NO
85	Subhu	38y	F	B	L	2.6	NO	Inferior calyx	39	0.7	NIL	200mg	4	No	Complete	0.7	NO
86	Munusamy	52y	M	B	R	2.4	HTN	Inferior calyx	51	0.6	NIL	200mg	5	uro sepsis	Complete	0.9	NO
87	Thangarasu	38y	M	B	R	3.3	NO	Inferior calyx	53	0.9	NIL	150mg	4	No	Complete	1	NO
88	Vinayagam	40y	M	B	R	3.4	DM	Middle calyx	54	1.7	2	250mg	5	uro sepsis	Complete	1.6	NO
89	Lalitha	50y	F	B	R	3.9	DM	Inferior calyx	62	0.6	NIL	150mg	4	No	Complete	1.4	NO
90	Sivalingam	70y	M	B	L	3.8	DM	Inferior calyx	53	0.7	NIL	150mg	4	No	Complete	1.2	NO
91	Munusamy	47y	M	B	L	3.1	NO	Superior calyx	51	0.5	NIL	150mg	4	No	Complete	0.7	NO
92	Kaliyarasu	35y	M	B	L	3	NO	Inferior calyx	52	1.2	1	150mg	4	No	Complete	0.7	NO
93	Prabhakaran	25y	M	B	R	2.9	NO	Inferior calyx	51	0.8	NIL	150mg	4	No	Complete	0.8	NO
94	Govinda raj	55y	M	B	L	2.5	DM	Inferior calyx	49	0.9	NIL	150mg	4	No	Complete	0.9	NO
95	Kaleeshwari	38y	F	B	R	3.5	NO	Middle calyx	48	0.5	NIL	200mg	4	No	Complete	0.7	NO
96	Govindammal	35y	F	B	R-B/L	3.4	NO	Inferior calyx	47	0.4	NIL	150mg	4	No	Complete	0.8	NO
97	Anjammal	50y	F	B	L	2.8	HTN	Inferior calyx	43	1.2	1	150mg	5	bleeding	Complete	1.3	NO
98	Balaji	46y	M	B	R	2.7	NO	Inferior calyx	42	0.9	NIL	200mg	4	No	Complete	0.7	NO
99	Sathya	53y	F	B	L	3	DM	Inferior calyx	44	0.7	NIL	150mg	4	No	Complete	0.7	NO
100	Subramani	33y	M	B	R-B/L	2.8	NO	Middle calyx	45	0.6	NIL	150mg	4	No	Complete	0.9	NO

APPENDIX 5

ABBREVIATIONS

PCNL- Percutaneous nephrolithotomy

PCN- Percutaneous nephrostomy

IVP- Intravenous pyelogram

CECT- Contrast enhanced computed tomography

DM- Diabetes mellitus

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"A COMPARATIVE STUDY OF STANDARD

VERSUS

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Dissertation submitted to

THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY

in partial fulfillment of the requirements for

the award of the degree of

M.Ch (UROLOGY) – BRANCH – IV

THE TAMILNADU DR.M.G.R.MEDICAL UNIVERSITY